UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

MASIMO CORPORATION, *Patent Owner/Appellant,* *v.* **APPLE INC.,** *Petitioner/Appellee.* **PROCEEDING NOS.: IPR2020-01520 IPR2020-01521, IPR2020-01536, IPR2020-01537, IPR2020-01538, IPR2020-01539, IPR2020-01714, and IPR2020-01715**	**APPEAL NOS.: 2022-1631** **2022-1632** **2022-1633** **2022-1634** **2022-1635** **2022-1636** **2022-1637** **2022-1638**

NOTICE FORWARDING CERTIFIED LISTS

Notices of Appeal to the United States Court of Appeals for the Federal Circuit were timely filed on April 12, 2022 in the United States Patent and Trademark Office ("USPTO") in connection with the above identified *Inter Partes* Review proceedings. Pursuant to 35 U.S.C. § 143, certified lists are this day being forwarded to the Federal Circuit.

Respectfully submitted,

KATHERINE K. VIDAL
Under Secretary of Commerce for
Intellectual Property and Director of the
United States Patent and Trademark Office

Date: May 23, 2022

By: */s/ Mekbib Solomon*
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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a true and correct copy of the foregoing **NOTICE FORWARDING CERTIFIED LISTS** was served on counsel for the Appellant and Appellee, via electronic mail, this 23rd day of May 2022, as follows:

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U.S. DEPARTMENT OF COMMERCE
UNITED STATES PATENT AND TRADEMARK OFFICE

May 23, 2022

THIS IS TO CERTIFY that the attached document is a list of the papers that comprise the record before the Patent Trial and Appeal Board (PTAB) for the *Inter Partes* Review proceeding identified below.

APPLE INC.,

Petitioner,

v.

MASIMO CORPORATION,

Patent Owner.

Case No.: IPR2020-01520
United States Patent No.: 10,258,265 B1

By authority of the
DIRECTOR OF THE UNITED STATES
PATENT AND TRADEMARK OFFICE

/s/ Mekbib Solomon
Certifying Officer

PROSECUTION HISTORY FOR *INTER PARTES* REVIEW NO.: IPR2020-01520

DATE	DESCRIPTION
08/31/2020	Petition for *Inter Partes* Review
08/31/2020	Petitioner's Power of Attorney
09/17/2020	Notice of Filing Date Accorded
09/21/2020	Patent Owner's Mandatory Notices
11/04/2020	Petitioner's Updated Exhibit List
12/17/2020	Patent Owner's Notice of Waiver of Preliminary Response
03/02/2021	Decision - Institution of *Inter Partes* Review Proceeding
03/02/2021	Scheduling Order
03/16/2021	Patent Owner's Objections to Evidence
04/08/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
04/16/2021	Patent Owner's Motion for *Pro Hac Vice* Admission – Jeremiah Helm
04/16/2021	Patent Owner's Motion for *Pro Hac Vice* Admission – William Zimmerman
04/16/2021	Patent Owner's Updated Exhibit List
04/20/2021	Decision Granting Patent Owner's Motions for *Pro Hac Vice* Admission
04/20/2021	Patent Owner's Amended Notice of Deposition - Thomas W. Kenny
04/21/2021	Patent Owner's Updated Mandatory Notice
04/21/2021	Patent Owner's Supplemental Power of Attorney – W. Zimmerman and J. Helm
04/22/2021	Petitioner's Motion to Submit Supplemental Information
05/06/2021	Order Granting Petitioner's Motion to Submit Supplemental Information
05/14/2021	Petitioner's Submission of Supplemental Information
05/28/2021	Patent Owner's Response
06/07/2021	Petitioner's Objections to Evidence
07/19/2021	Petitioner's Notice of Deposition - Vijay K. Madisetti
08/20/2021	Petitioner's Reply to Patent Owner's Response
08/27/2021	Patent Owner's Objections to Evidence
09/09/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
10/01/2021	Patent Owner's Sur-Reply
10/08/2021	Petitioner's Objections to Evidence
10/20/2021	Petitioner's Request for Oral Hearing
10/22/2021	Patent Owner's Request for Oral Argument
10/28/2021	Patent Owner's Supplemental Mandatory Notices
11/01/2021	Order Setting Oral Argument
11/22/2021	Petitioner's Identification of Testimony
12/03/2021	Petitioner's Updated Exhibit List
12/03/2021	Patent Owner's Demonstratives for Trial Hearing
01/06/2022	Oral Hearing Transcript
01/10/2022	Petitioner's Updated Mandatory Notices
02/23/2022	Final Written Decision
04/12/2022	Notice of Appeal

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Paper 39
Date: February 23, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

IPR2020-01520
Patent 10,258,265 B1

Before GEORGE R. HOSKINS, ROBERT L. KINDER, and AMANDA F. WIEKER, *Administrative Patent Judges*.

HOSKINS, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Apple Inc. (“Petitioner”) filed a Petition (Paper 2, “Pet.”) pursuant to 35 U.S.C. §§ 311–319 to institute an *inter partes* review of U.S. Patent No. 10,258,265 B1 (“the ’265 patent”), claims 1–4, 6–14, and 16–30. We instituted the petitioned review (Paper 7, “Institution Decision” or “Inst. Dec.”).

Masimo Corporation (“Patent Owner”) filed a Patent Owner Response (Paper 21, “PO Resp.”) to oppose the Petition. Petitioner filed a Reply (Paper 24, “Pet. Reply”) to the Patent Owner Response. Patent Owner filed a Sur-reply (Paper 27, “Sur-reply”) to the Reply. With prior authorization from the Board, Petitioner filed an Identification of Testimony (Paper 33) in response to the Sur-reply. An oral hearing was held, for which the transcript was entered into the record (Paper 37, “Tr.”).

We have jurisdiction under 35 U.S.C. § 6(b)(4) and § 318(a). This Decision is a final written decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as to the patentability of claims 1–4, 6–14, and 16–30 of the ’265 patent. We determine Petitioner has shown by a preponderance of the evidence that those claims are unpatentable.

II. BACKGROUND

A. Real Parties-in-Interest and Related Proceedings

Petitioner identifies itself as the sole real party-in-interest for Petitioner. Pet. 104. Patent Owner identifies itself as the sole real party-in-interest for Patent Owner. Paper 4, 1.

The parties identify one district court litigation as related to this proceeding: *Masimo Corp. et al. v. Apple Inc.*, Civil Action No. 8:20-cv-

00048 (C.D. Cal.). Pet. 105; Paper 4, 1. We are also aware of several other IPR proceedings challenging other patents at issue in that litigation. *See, e.g.*, Pet. 105; Paper 4, 3.

B. The ’265 Patent

The ’265 patent concerns noninvasive devices for measuring blood analytes such as glucose, or other physiological characteristics such as pulse rate. *See* Ex. 1001, code (57), 2:20–30. Figures 3C and 3E are reproduced below:

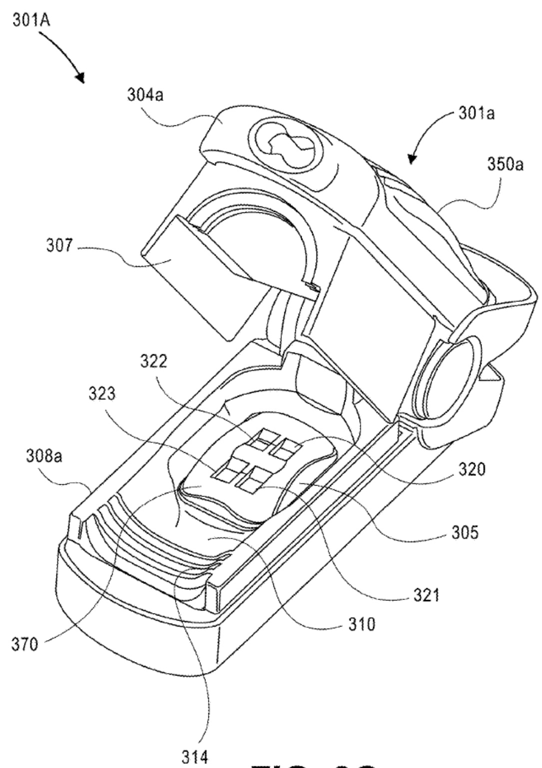


FIG. 3C

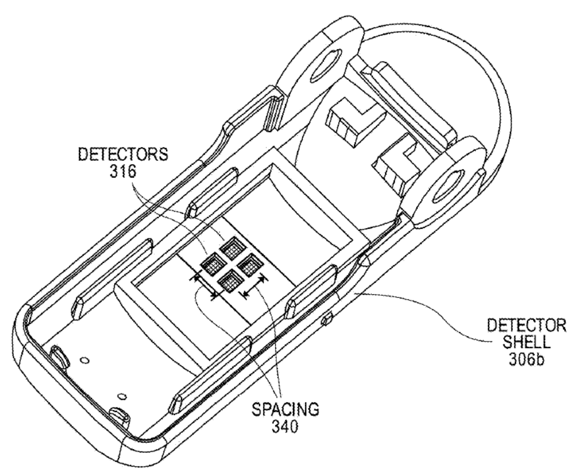


FIG. 3E

Figure 3C is a perspective view of sensor 301a, comprising upper emitter shell 304a pivotably connected to lower detector shell 306a, to sandwich a person’s finger between the shells. *See id.* at 5:52–55, 18:39–51. Figure 3E is a perspective view of detector shell 306b of a different but similar sensor 301b. *See id.* at 5:59–61, 22:21–40 (“The features described with

respect to the detector shell 306b can also be used with the detector shell 306a of the sensor 301a.”).

Emitter shell 304a houses emitter components (not shown in Figure 3C) such as LEDs, which emit light of different wavelengths, such as visible light, near infrared light, or infrared light. *See id.* at 5:3–7, 12:3–12, 13:8–15, 18:40–42, 18:62–63.

Detector shell 306a / 306b houses four photodetectors 316, one underneath each window 320–323 within finger bed 310 formed on top of the shell. *See id.* at 19:4–5, 19:13–16, 19:38–48. Finger bed 310 includes “a tissue thickness adjustor or protrusion 305,” which may be removed and interchanged with other protrusions 305 to correspond to different finger characteristics. *Id.* at 19:29–37.

Sensor 301a operates in the following manner. A person places a finger on finger bed 310, and upper emitter shell 304a pivots toward lower detector shell 306a / 306b to hold the finger in place, and to shield the interior of sensor 301a from interference by ambient light. *See id.* at 16:52–64, 18:43–51, 18:66–19:20. Then, the emitters housed in emitter shell 304a emit light of different wavelengths, to pass through the person’s finger and into windows 320–323 within finger bed 310, to reach photodetectors 316. *See id.* at 19:38–48. Photodetectors 316 capture and measure the light, which has been attenuated by the person’s finger tissue, and output responsive signals to a processor that uses the signals to derive a physiological parameter of the person. *See id.* at 2:20–30, 10:30–39, 10:62–11:1, 14:11–19, 15:31–35, 18:39–42.

Another detector subassembly is shown in Figure 14D, reproduced below:

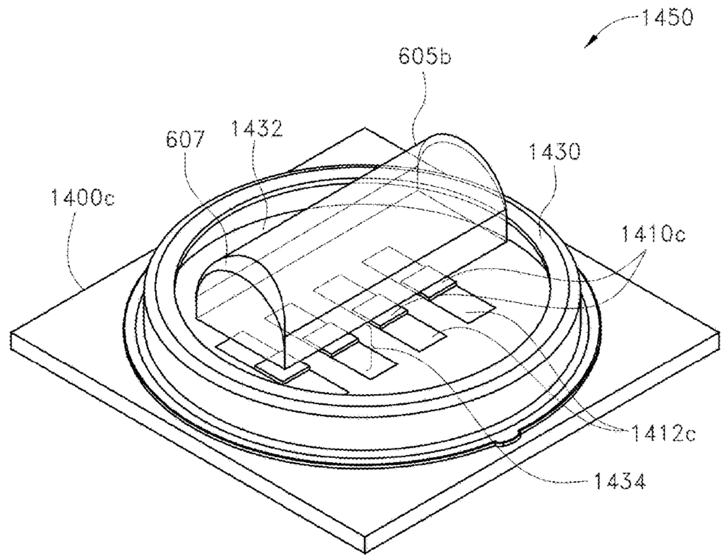


FIG. 14D

Figure 14D shows detector subassembly 1450 including submount 1400c, cylindrical housing 1430, transparent cover 1432 with protrusion 605b disposed on it, and four detectors 1410c. *See id.* at 6:54–55, 36:38–47. The light focusing properties provided by protrusion 605b advantageously reduce the number of detectors, or rows of detectors, that are required. *See id.* at 35:56–36:10; *see also id.* at Fig. 14B, 36:11–30 (illustrating and describing function of a "partially cylindrical protrusion 605 (or alternatively, the protrusion 605b)" to focus light on detector(s) 1410b).

C. The Claims of the '265 Patent

The '265 patent lists thirty claims, including two independent claims, claims 1 and 26. Ex. 1001, 44:65–47:20. We reproduce illustrative claim 1 here:

> 1. A noninvasive optical physiological measurement device adapted to be worn by a wearer, the noninvasive optical physiological measurement device providing an indication of a physiological parameter of the wearer comprising:
>
> a plurality of emitters of different wavelengths;
>
> a housing having a surface and a circular wall protruding from the surface;
>
> at least four detectors arranged on the surface and spaced apart from each other, the at least four detectors configured to output one or more signals responsive to light from the one or more light emitters attenuated by body tissue, the one or more signals indicative of a physiological parameter of the wearer; and
>
> a light permeable cover arranged above at least a portion of the housing, the light permeable cover comprising a protrusion arranged to cover the at least four detectors.

Id. at 44:66–45:15.

D. Prior Art and Asserted Grounds

Petitioner relies on the following eight prior art references. *See* Pet. 1–3.

Name	**Reference**	**Date**	**Exhibit No(s).**
Aizawa	US 2002/0188210 A1	Dec. 12, 2002	1006
Beyer	US 7,031,728 B2	Apr. 18, 2006	1019
Goldsmith	US 2007/0093786 A1	Apr. 26, 2007	1027
Inokawa	JP 2006-296564 A	Nov. 2, 2006	1007 & 1008[1]
Lo	US 2004/0138568 A1	July 15, 2004	1028

[1] Exhibit 1007 is the reference, which was published in the Japanese language, and Exhibit 1008 is a certified English language translation.

Name	Reference	Date	Exhibit No(s).
Mendelson -1988	Y. Mendelson, et al., *Design and Evaluation of a New Reflectance Pulse Oximeter Sensor*, Medical Instrumentation, Vol. 22, No. 4, 167–173 (1988)	Aug. 1988	1015
Mendelson -2006	Y. Mendelson, et al., *A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring*, Proceedings of the 28th IEEE EMBS Annual Int'l Conf., 912–915 (2006)	Dec. 26, 2007[2]	1016
Ohsaki	US 2001/0056243 A1	Dec. 27, 2001	1014

Petitioner relies on the following eight grounds of unpatentability, all under 35 U.S.C. § 103. *See* Pet. 1–2.

Ground	Claim(s) Challenged	References
1A	1–4, 6–14, 16, 17, 19–23, 26–29	Aizawa, Inokawa
1B	1–4, 6–14, 16, 17, 19–23, 26–29	Aizawa, Inokawa, Ohsaki
1C	23, 24	Aizawa, Inokawa, Mendelson-2006
1D	23, 24	Aizawa, Inokawa, Goldsmith, Lo

[2] This date for Mendelson-2006 is taken from the Petition (page 3), as the date when the reference "was first cataloged by Cornell University's library" (Ex. 1026 ¶¶ 11–14).

Ground	Claim(s) Challenged	References
1E	25	Aizawa, Inokawa, Mendelson-2006, Beyer
2A	1–4, 6–14, 16–22, 26–30	Mendelson-1988, Inokawa
2B	23, 24	Mendelson-1988, Inokawa, Mendelson-2006
2C	25	Mendelson-1988, Inokawa, Mendelson-2006, Beyer

E. Testimonial Evidence

Petitioner relies on the declaration testimony of Thomas W. Kenny, Ph.D. (Exhibits 1003 and 1047). Patent Owner relies on the declaration testimony of Vijay K. Madisetti, Ph.D. (Exhibit 2004).

III. ANALYSIS

A. Statement of Law

Petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). Petitioner must prove unpatentability by a preponderance of the evidence. *See* 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

A patent claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406

(2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of non-obviousness, if made available in the record.[3] *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

Petitioner contends a person having ordinary skill in the art pertaining to the ’265 patent (“POSITA”) would have “a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information.” Pet. 3–4; Ex. 1003 ¶¶ 21–22. “Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline.” Pet. 4; Ex. 1003 ¶ 21.

Patent Owner “applies Petitioner’s level of skill.” PO Resp. 10; Ex. 2004 ¶¶ 35–38. Patent Owner emphasizes that this level of skill requires no specific education or experience “with optics or optical physiological monitors” or “in physiology,” and instead “focuses on data processing and not sensor design.” PO Resp. 10; Ex. 2004 ¶ 37.

Petitioner’s POSITA formulation is reasonable based on the record and the agreement of the parties. We also determine it is consistent with the

[3] The parties have not produced any objective evidence of non-obviousness.

’265 patent claims and the prior art of record. We adopt Petitioner’s POSITA formulation in this Decision.

C. Claim Construction

We interpret the ’265 patent claims “using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).” 37 C.F.R. § 42.100(b). This “includ[es] construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” *Id.*

Petitioner asserts “no formal claim constructions are necessary in this proceeding.” Pet. 3. Patent Owner construes one claim term, “cover,” seeking to distinguish Mendelson-1988 from the claims. *See* PO Resp. 9, 50–51. We address that claim construction here.

1. “cover”

Independent claim 1 requires “a light permeable cover,” and independent claim 26 requires “a cover . . . comprising a lens portion.” Ex. 1001, 45:13–15, 46:58–60.

Patent Owner argues the claimed “cover” must be construed to exclude “an optically clear adhesive/epoxy” and a “resin on a surface.” PO Resp. 50; Ex. 2004 ¶¶ 111–114. Patent Owner asserts “the ’265 Patent distinguishes a resin on a surface from a cover, explaining: ‘the cylindrical housing 1430 (and transparent cover 1432) . . . can protect the detectors 1410c and conductors 1412c ***more effectively*** than currently-available ***resin epoxies***.” PO Resp. 50–51 (quoting Ex. 1001, 36:58–67).

Patent Owner alleges Dr. Kenny also "distinguished a sealing resin from a cover, acknowledging a 'layer of sealing resin' is 'one way to protect the components ***without using a cover***.'" *Id.* at 51 (quoting Ex. 2009, 395:22–396:17); Ex. 2004 ¶ 113. Patent Owner argues its construction is consistent with the prior art. PO Resp. 51 (citing Ex. 1008 ¶ 103, Fig. 17; Ex. 1012, 5:2–6, Fig. 2B; Ex. 1013 ¶ 32, Fig. 2; Ex. 1023 ¶ 35; Ex. 1027 ¶ 85, Fig. 9B); Ex. 2004 ¶ 114.

Petitioner replies that "there is nothing in the specification or the prosecution history [of the '265 patent] that would lead a POSITA to conclude that 'cover' should be interpreted based on anything other than its plain meaning." Pet. Reply 27 (citing *Thorner v. Sony Computer Entertainment America LLC*, 669 F.3d 1362, 1368 (Fed. Cir. 2012)). That plain meaning, according to Petitioner, is that "a cover is merely 'something that protects, shelters, or guards.'" *Id.* (quoting Ex. 1050); Ex. 1047 ¶ 56. Petitioner argues Patent Owner's reliance on the '265 patent specification takes certain text out of context, and when this context is considered, it is clear that "the epoxy resin to which the '265 patent compares its cover is not [an] epoxy cover . . . but rather epoxy that is applied to solder joints." Pet. Reply 28 (citing Ex. 1001, 36:58–67); Ex. 1047 ¶ 58.

Petitioner accuses Patent Owner of mischaracterizing Dr. Kenny's testimony, because he "clarified that using a sealing resin is 'a pretty common way to protect electronic components.'" Pet. Reply 28 (citing Ex. 2009, 395:22–396:17); Ex. 1047 ¶ 57. Further according to Petitioner, "such extrinsic evidence would not justify departure from plain meaning under *Thorner*." Pet. Reply 28.

Patent Owner maintains in response that the ’265 patent specification disclosure at issue “specifically ***distinguishes*** a ‘resin’ on a surface from a ‘cover,’” and Petitioner’s reading of this disclosure is not persuasive. Sur-reply 22–23.

Upon review of the foregoing, we disagree with Patent Owner’s limiting construction of the term “cover” to exclude epoxy and resin. The plain and ordinary meaning of the term does not support Patent Owner’s construction. A “cover” ordinarily connotes “something that protects, shelters, or guards.” Ex. 1050 (*Merriam-Webster’s Collegiate Dictionary*, 11th ed. (©2005)), 288. That plain and ordinary meaning is consistent with the ’265 patent’s description of “flex circuit cover 360, which can be made of plastic or another suitable material . . . [and] can cover and thereby protect a flex circuit (not shown).” Ex. 1001, 23:17–26. It is also consistent with the ’265 patent’s description and illustration of “transparent cover 1432” in Figure 14D, which covers and protects detectors 1410c and conductors 1412c, and which “can be fabricated from glass or plastic, *among other materials*.” *See id.* at 36:38–67 (emphasis added), Figs. 14D–14E.

Any special definition for a claim term must be set forth in the specification with reasonable clarity, deliberateness, and precision, so as to give notice of the inventor’s own lexicography. *See Merck & Co. v. Teva Pharms. USA, Inc.*, 395 F.3d 1364, 1370 (Fed. Cir. 2005); *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Similarly: “The patentee may demonstrate an intent to deviate from the ordinary and accustomed meaning of a claim term by including in the specification expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope.”

Teleflex, Inc. v. Ficosa North America Corp., 299 F.3d 1313, 1325 (Fed. Cir. 2002) (citation omitted).

Here, based on our review of the intrinsic evidence, no such special definition or express disavowal of the term "cover" to exclude epoxy and resin exists. Patent Owner relies on the following description of Figure 14D in this regard:

> In certain embodiments, *the cylindrical housing 1430 (and transparent cover 1432)* forms an airtight or substantially airtight or hermetic seal with the submount 1400c. As a result, the cylindrical housing 1430 can protect the detectors 1410c and conductors 1412c from fluids and vapors that can cause corrosion. Advantageously, *in certain embodiments, the cylindrical housing 1430 can protect* the detectors 1410c and conductors 1412c *more effectively than currently-available resin epoxies*, which are sometimes applied to solder joints between conductors and detectors.

Ex. 1001, 36:58–67 (emphases added). First, the sentence cited by Patent Owner begins with the phrase "Advantageously, in certain embodiments," which indicates the claimed invention is open to other embodiments, so there is no lexicography or disavowal here. Second, we agree with Petitioner's reading of this sentence as distinguishing the prior art from the claimed invention based on the *location* of the material (being applied only to solder joints between conductors and detectors in the prior art, as opposed to covering the conductors and detectors in the invention) and not the *type* of material. Third, at best for Patent Owner, the '265 patent expresses a preference for a cover to be made of glass or plastic, because such materials provide "more effective[]" protection than resin epoxies that were known to the inventors of the '265 patent when it was filed. *See id.* at 36:50–67. But even this reading recognizes that resin epoxies provide some amount of

protection, albeit a lesser amount than glass or plastic, and therefore may in some embodiments provide a cover.

The prior art references cited by Patent Owner do not persuade us otherwise. Patent Owner cites various descriptions of a "cover" in the prior art, but they do not even identify a material for the cover, much less suggest that a cover may not be made of epoxy or resin. *See* Ex. 1008 ¶ 103 (cover 123); Ex. 1012, 5:2–6 (cover plate 21); Ex. 1013 ¶ 32 (cover 200); Ex. 1027 ¶ 85 (cover 960). Patent Owner cites another reference which describes materials 30, 40 and 50 as formed of a "thermoplastic resin," and illustrates these materials as covering LED 22 and bonding wire 23, but does not describe the materials as being a "cover." Ex. 1023 ¶ 35, Fig. 6. This does not mean a POSITA would fail to consider these materials as being a "cover," despite that this specific term was not used in the reference.

Dr. Kenny's deposition testimony cited by Patent Owner also does not persuade us otherwise. Dr. Kenny testifies that "a layer of sealing resin" "could" be used to protect the electronic components in a sensor (Ex. 2009, 395:22–396:8). He was then asked "So that would be one way to protect the components without using a cover, correct?" to which he answered "There are many ways to protect the elements other than using a cover" and maintained his proposed combination of prior art has a "cover" to achieve purposes other than protecting electronic components. *Id.* at 396:9–17. He did not squarely testify that sealing resin could not ever be a cover.

Thus, we do not construe the claimed "cover" to exclude epoxy and resin.

2. Other Claim Terms

Upon consideration of the entirety of the arguments and evidence presented, we conclude no further explicit construction of any claim term is needed to resolve the issues presented by the arguments and evidence of record. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (per curiam) (claim terms need to be construed "only to the extent necessary to resolve the controversy" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Ground 1A — Obviousness over Aizawa and Inokawa

In Ground 1A, Petitioner argues claims 1–4, 6–14, 16, 17, 19–23, and 26–29 of the '265 patent would have been obvious over Aizawa and Inokawa. Pet. 1–2, 6–48. Patent Owner opposes. PO Resp. 11–40. We conclude a preponderance of the evidence supports Petitioner's assertions as to all challenged claims. We begin our analysis with brief summaries of Aizawa and Inokawa, then we address the parties' contentions.

1. Aizawa Disclosure

Aizawa discloses a pulse rate detector comprising a sensor worn on a user's wrist. Ex. 1006, code (57). Figures 1(a) and 1(b) are reproduced below:

FIG. 1 (a)

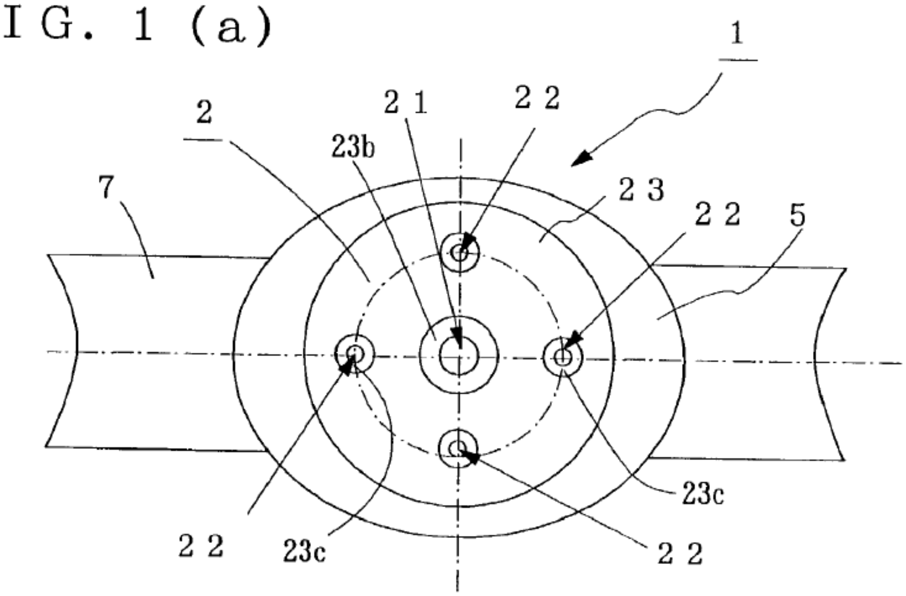


FIG. 1 (b)

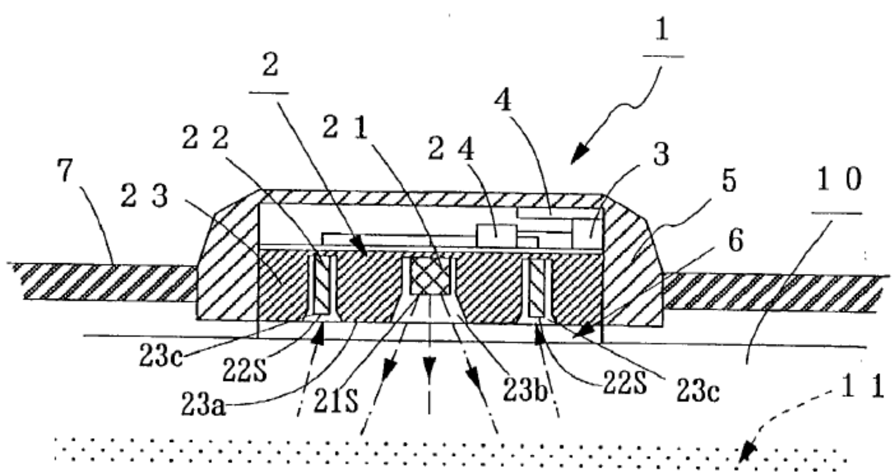


Figure 1(a) is a schematic underside view, and Figure 1(b) is a schematic cross-sectional side view, of pulse rate detector 1 including pulse rate sensor 2, and belt 7 to be wrapped around a user's wrist 10. *Id.* ¶¶ 17, 23, 26. Sensor 2 includes LED 21 which emits near infrared light. *Id.* ¶¶ 23, 27. The emitted light enters the user's wrist 10 and reflects off red corpuscles in artery 11. *Id.* ¶ 27. Some of the reflected light is received by four photodetectors 22 arranged around LED 21. *Id.* ¶¶ 23, 27. Associated

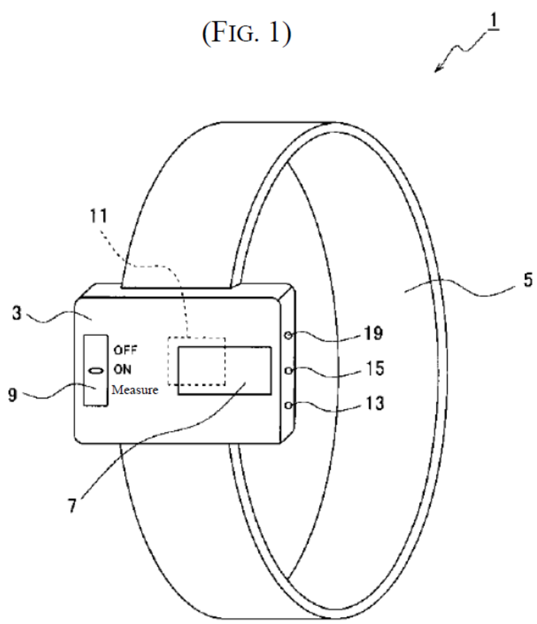
electronics 3, 4, and 24 gather and process signals from photodetectors 22 to generate a pulse wave indicative of the user's pulse, and transmit the pulse wave to an unshown display for display to the user. *Id.*

Detector 1 includes holder 23 to hold LED 21 and photodetectors 22 in place. *Id.* ¶ 23. Acrylic transparent plate 6 is disposed between holder 23 and the user's wrist 10. *Id.* ¶¶ 23, 26, 30. "[B]elt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10," and "[t]hereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶ 26. "Since the acrylic transparent plate 6 is provided on the detection face 23a of the holder 23, adhesion between the pulse rate detector 1 and the wrist 10 can be improved, thereby further improving the detection efficiency of a pulse wave." *Id.* ¶ 30.

2. *Inokawa Disclosure*

Inokawa discloses an optical vital sensor system worn on a user's wrist. *See* Ex. 1008, code (57), ¶ 56. Figures 1 and 2 are reproduced below:

(FIG. 1)



(FIG. 2)

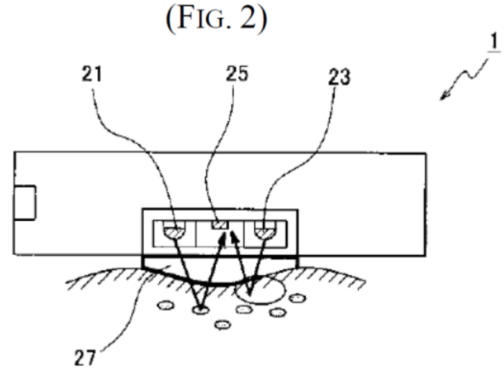


Figure 1 is a perspective view, and Figure 2 is a diagrammatic side view, of "a pulse sensor 1 that is able to sense the pulse, etc. by being attached, for example, to a person's . . . wrist" via wristband 5. *Id.* ¶¶ 56–57, 119.

Sensor unit 3 has green LED 21 and infrared LED 23, with a single photodiode 25 to detect light emitted from both LEDs and reflected from the user's wrist, as shown by arrows in Figure 2. *Id.* ¶¶ 57–58. The "basic function of . . . green LED 21 is to sense the pulse . . . while the . . . infrared LED 23 serves to sense body motion." *Id.* ¶ 59.

Pulse sensor 1 includes lens 27, which "makes it possible to increase the light-gathering ability of the LED as well as to protect the LED or [photodiode 25]." *Id.* ¶¶ 15, 58.

Pulse sensor 1 also uses LEDs 21 and 23 to download data to a base station, as shown in Figure 3, reproduced below.

(FIG. 3)

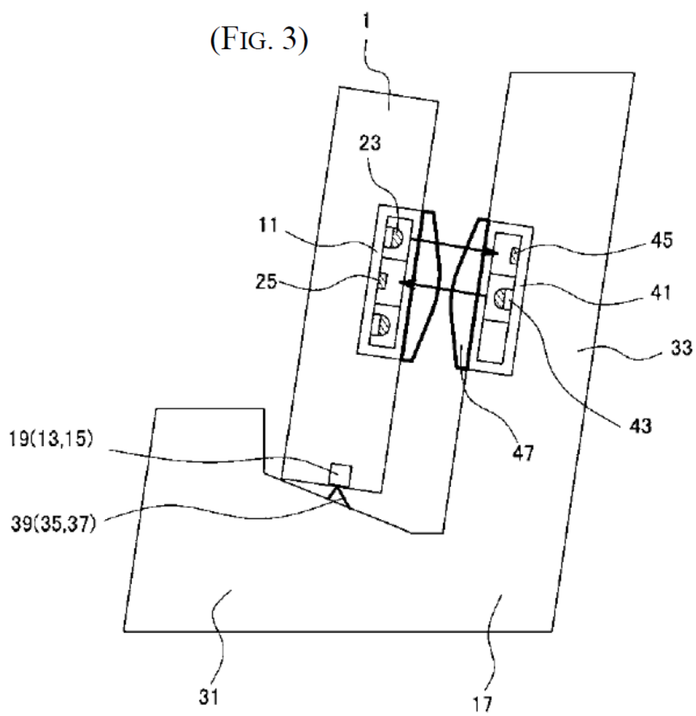


Figure 3 illustrates pulse sensor 1 mounted on base station 17. *Id.* ¶¶ 60, 66. Vital sign information stored in sensor 1 is downloaded to base station 17,

which forwards the information to a personal computer 59 (shown in Figure 7). *Id.* ¶¶ 66–67. Specifically, this information is encoded into light emitted by infrared LED 23 of sensor 1 and detected by photodetector 45 of base station 17. *Id.* ¶¶ 66–67, 76. At the same time, green LED 21 may transmit "checksum" information to another photodetector of base station 17 (as shown in Figure 19), to increase the accuracy of data transmission. *Id.* ¶ 14; *see also id.* ¶¶ 109–111 (describing how "the presence of two pairs of light-emitting and light-receiving elements makes it possible to efficiently transmit information"). Mounting sensor 1 on base station 17 further permits sensor 1 to be electrically charged via terminals 19 and 39. *Id.* ¶¶ 60, 66, Fig. 7.

"As a result" of this optical data communication from sensor 1 to base station 17, "there is no need to use a special wireless communication circuit or a communication cable as previously, which makes it possible to transmit vital sign information to the base device 17 accurately, easily, and without malfunction." *Id.* ¶ 77; *see also id.* ¶¶ 3–7 (describing a "problem" in prior art devices that require "a dedicated wireless communication circuit" to "transmit data wirelessly," which is overcome by Inokawa's optical data communication to a base station because the dedicated wireless communication circuit is unnecessary).

3. Claim 1

Petitioner provides arguments and evidence, including testimony from Dr. Kenny, in support of contending claim 1 is unpatentable as having been obvious over Aizawa and Inokawa. Pet. 6–29; Ex. 1003 ¶¶ 53–63, 73–99.

Patent Owner provides arguments and evidence in opposition, including testimony from Dr. Madisetti. PO Resp. 11–40; Ex. 2004 ¶¶ 34, 39–88.

a) Comparing Claim 1 with Aizawa

Petitioner contends Aizawa's pulse rate detector 1 exhibits each and every limitation of claim 1, except that it has only one emitter (i.e., LED 21) of near infrared light instead of the claimed "plurality of emitters of different wavelengths," and its light permeable cover (i.e., acrylic transparent plate 6) lacks the claimed "protrusion." *See* Pet. 6–9, 22–29; Ex. 1003 ¶¶ 53–58, 73–99. Patent Owner does not challenge Petitioner's contentions in this regard. We determine these contentions are supported by a preponderance of the evidence, as follows.

As pertinent to the undisputed limitations of claim 1, we find Aizawa's detector 1 is a noninvasive optical measurement device adapted to be worn on a user's wrist, to provide an indication of a physiological parameter of the user (i.e., pulse wave).[4] *See* Ex. 1006, Fig. 2, ¶¶ 2, 26; Pet. 22–23; Ex. 1003 ¶ 73. We find Aizawa's detector 1 has a single emitter (i.e., LED 21) of one wavelength (i.e., near infrared light). *See* Ex. 1006, Figs. 1(a)–1(b), ¶¶ 23, 27; Pet. 6–7, 23–24; Ex. 1003 ¶¶ 53–54, 74. We find Aizawa's detector 1 includes a housing having a surface and a circular wall protruding from the surface. *See* Ex. 1006, Figs. 1(a)–1(b) & 2, ¶¶ 23–24; Ex. 1003 ¶¶ 87–88. In particular, Petitioner annotates Aizawa's Figures to identify the "Housing" in red, the "Surface" in brown, and the "Circular wall" in purple. *See* Pet. 24–25; Ex. 1003 ¶¶ 87–88.

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[4] Whether the preamble is limiting need not be resolved, because the recitation in the preamble is satisfied by the prior art.

We find Aizawa's detector 1 further includes four detectors (i.e., photodetectors 22) arranged on the housing's surface and spaced apart from each other, symmetrically on a circle centered on LED 21. *See* Ex. 1006, Figs. 1(a)–1(b), ¶¶ 24, 29, 32; Pet. 25–27; Ex. 1003 ¶¶ 89–90. We find Aizawa's photodetectors 22 are configured to output signals responsive to light emitted from LED 21 and attenuated by the user's body tissue, and the signals are indicative of the user's pulse wave. *See* Ex. 1006 ¶¶ 23, 27, 28; Pet. 27; Ex. 1003 ¶ 91.

We find Aizawa's detector 1 has a light permeable cover (i.e., plate 6) mounted at detection face 23a of holder 23, to cover four photodetectors 22. *See* Ex. 1006, Fig. 1(b), ¶ 23; Pet. 28–29; Ex. 1003 ¶¶ 92–93.

b) Comparing Claim 1 with Inokawa

Petitioner contends Inokawa's pulse sensor 1 is a noninvasive optical measurement device having two emitters (i.e., LEDs 21 and 23) of different wavelengths, and a light permeable cover (i.e., lens 27) comprising a protrusion arranged to cover its light detector (i.e., detector 25). *See* Pet. 9–11; Ex. 1003 ¶¶ 59–63, 73–99. Patent Owner does not challenge Petitioner's contentions in this regard. We determine these contentions are supported by a preponderance of the evidence, as follows.

As pertinent to the undisputed limitations of claim 1, we find Inokawa's pulse sensor 1 is a noninvasive optical measurement device adapted to be worn on a user's wrist, to provide an indication of two physiological parameters of the user (i.e., pulse and body motion). *See* Ex. 1008, Figs. 1 & 2, ¶¶ 14, 56–59; Pet. 9–10; Ex. 1003 ¶¶ 59–60. We find this is accomplished using light from green LED 21 to monitor the user's

pulse, and using light from infrared LED 23 to monitor the user's motion, both using detector 25. *See* Ex. 1008, Fig. 2, ¶¶ 14, 58–59; Pet. 10; Ex. 1003 ¶ 60.

We find Inokawa's pulse sensor 1 also has a light permeable cover (i.e., lens 27), which according to Inokawa "makes it possible to increase the light-gathering ability of the LED as well as to protect the LED or [photodiode 25]." Ex. 1008, Fig. 2, ¶¶ 15, 58; Pet. 10; Ex. 1003 ¶ 61. We find lens 27 comprises a protrusion that covers the device's detector 25. Ex. 1008, Fig. 2; Pet. 10–11; Ex. 1003 ¶¶ 61, 95–96.

c) Obviousness of Combining Aizawa and Inokawa

Petitioner contends a POSITA would have been motivated to modify Aizawa's pulse rate detector 1, in light of Inokawa's disclosures, by: (1) adding a second emitter to emit light of a different wavelength, so that Aizawa's detector 1 can monitor the user's body motion for improved pulse detection, and so that detector 1 can transmit information more reliably to a base device with less error; and (2) adding a protrusion to Aizawa's cover 6 to improve the sensor's light detection efficiency. *See* Pet. 13–22. Patent Owner opposes these contentions, and argues a person of ordinary skill in the art would not have had a reasonable expectation of success, among other things. *See* PO Resp. 15–40. We consider each modification in turn.

(1) Plurality of Emitters of Different Wavelengths

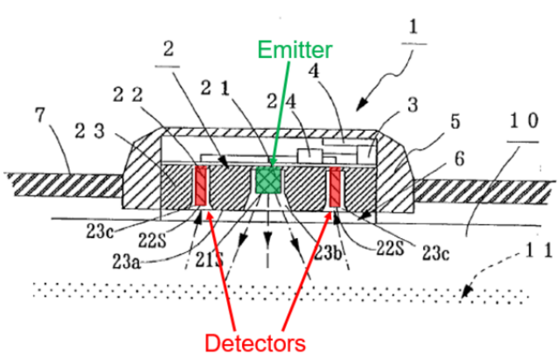
(i) Petitioner's Contentions

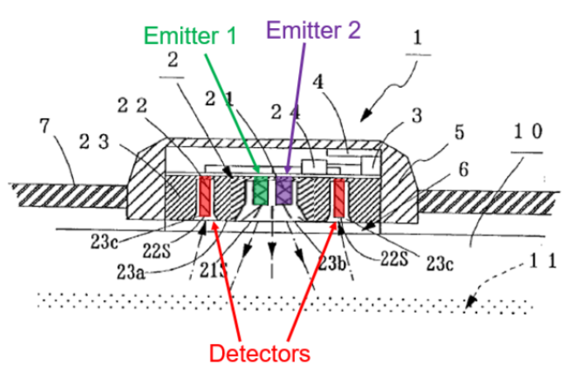
Petitioner asserts that, "[w]hile Aizawa contemplates the use of multiple emitters, Aizawa never specifically identifies the use of multiple emitters operating at different wavelengths in conjunction with multiple

detectors." Pet. 17 (citing Ex. 1006 ¶ 33); Ex. 1003 ¶ 74. Inokawa, in Petitioner's view, discloses using an infrared LED "to detect vital signs and transmit vital sign information," and a separate green LED "to detect pulse." Pet. 17 (citing Ex. 1008 ¶¶ 14, 44, 58–59); Ex. 1003 ¶ 75.

Petitioner asserts a POSITA "would have recognized Inokawa's use of two different emitters operating at different wavelengths as a desirable configuration that would reap similar benefits for Aizawa." Pet. 17; Ex. 1003 ¶ 76. Specifically: "A POSITA would have recognized, in view of Inokawa, that providing an additional emitter to Aizawa would allow Aizawa's device to use its existing infrared LED to detect body motion while using the added green LED to detect pulse." Pet. 17–18 (citing Ex. 1008 ¶ 59), 23–24; Ex. 1003 ¶¶ 76–79. Dr. Kenny concludes "[t]he added ability to measure body movement in this manner will allow for a more reliable measurement that can, for instance, take into account and correct for inaccurate readings related to body movement," because "the signal component corresponding to body movement can be subtracted from the pulse signal to help better isolate the desired pulse data." Ex. 1003 ¶ 77 (citing Exhibit 1010, 8:45–50); Pet. 18.

Petitioner provides the following illustrations to portray the proposed modification of Aizawa's pulse rate detector 1. *See* Pet. 18; Ex. 1003 ¶ 77.





At the left, Petitioner has annotated Aizawa's Figure 1(b), to identify Aizawa's pre-existing single near infrared emitter 21 (colored green) in relation to two of Aizawa's four detectors 22 (colored red). *See* Pet. 18–19. At the right, Petitioner has shown the proposed modification, which would include two different emitters (colored green and purple), operating at two different wavelengths. *See id*.

As a second and independent motivation "for improving Aizawa by adding a second LED/emitter," Petitioner contends "Aizawa contemplates uploading data to a base device yet is silent about how such data transmission would be implemented, instead leaving such implementation details to the POSITA." Pet. 19–20 (citing Ex. 1006 ¶¶ 15, 23, 35); Ex. 1003 ¶ 80. Inokawa, in Petitioner's view, discloses how a wrist-worn pulse sensor 1 can transmit data to base device 17 using infrared LED 23, which advantageously means "it is not necessary to use a wireless communication circuit or to establish connections via communication cable, which makes it possible to easily transmit vital sign information with few malfunctions and with a simple structure." Pet. 19–21 (quoting Ex. 1008 ¶ 7, and citing *id.* at Fig. 3, ¶ 60); Ex. 1003 ¶¶ 81–82.

Petitioner further concludes: "A POSITA would have been motivated and found it obvious and straightforward to incorporate Inokawa's base device and LED-based data transmission into Aizawa to, for instance, 'make[] it possible to transmit vital sign information to the base device 17 accurately, easily, and without malfunction.'" Pet. 20–21 (quoting Ex. 1008 ¶ 77); *id.* at 23–24; Ex. 1003 ¶¶ 83–84. In particular, according to Petitioner, Inokawa "teaches that using ***two LEDs*** further helps improve data transmission accuracy by using the second LED, such as green LED, to

transmit checksum information such that 'the accuracy of data can be increased.'" Pet. 21 (citing Ex. 1008, Fig. 19, ¶¶ 44, 48, 111); Ex. 1003 ¶ 83. In Petitioner's view, this provides motivation "to supplement Aizawa's IR LED/emitter with a green LED/emitter to, as per Inokawa, improve accuracy of data transmission from its sensor." Pet. 21–22; Ex. 1003 ¶ 84.

(ii) Patent Owner's Contentions

Patent Owner argues Petitioner's case for the obviousness of modifying Aizawa to have two emitters of different wavelengths is not supported by the evidence of record. *See* PO Resp. 11–13, 34–40; Sur-reply 15–17.

Patent Owner firstly contends the combination of Aizawa and Inokawa does not result in the claimed invention, which requires a "plurality" of emitters and "at least four" detectors. PO Resp. 34. Patent Owner correctly points out that neither Aizawa nor Inokawa discloses a device meeting both of those claim requirements, because Aizawa's embodiments have either a single emitter and multiple detectors (e.g., Ex. 1006, Fig. 1(a)) or multiple emitters and a single detector (e.g., *id.* ¶ 33), and Inokawa discloses multiple emitters and a single detector (e.g., Ex. 1008, Fig. 2). *See* PO Resp. 11–13, 34–36 (citing Ex. 1006, code (57), ¶¶ 33, 26–27, Figs. 1, 2, 4, & 5; Ex. 1008 ¶ 58, Fig. 2); Ex. 2004 ¶¶ 40–43, 79–80. Patent Owner concludes, therefore, that a POSITA seeking to improve upon Aizawa's device to incorporate two emitters would be limited to "positioning multiple LEDs around a ***single*** detector" based on the combined disclosures of Aizawa and Inokawa. PO Resp. 35; Ex. 2004

¶¶ 81–83. Patent Owner argues Dr. Kenny's testimony in this regard "conflicts with the references themselves" and so "is not credible." PO Resp. 35–36 (citing Ex. 1003 ¶¶ 55, 77).

Patent Owner secondly contends the evidence does not support either of Petitioner's two proffered motivations for modifying Aizawa to have two emitters of different wavelengths. As to the first motivation of adding the capability to measure body movement using a second emitter to correct for inaccurate pulse readings, Patent Owner asserts Dr. Kenny erroneously testifies that Aizawa cannot do this with its single emitter. PO Resp. 36 (citing Ex. 1006 ¶ 15; Ex. 2007, 400:7–401:10); Ex. 2004 ¶ 84. This is because Aizawa states its pulse rate detector comprises "a device for computing the amount of motion load from the pulse rate." Ex. 1006 ¶ 15; PO Resp. 36; Ex. 2004 ¶ 84.

As to Petitioner's second motivation of enabling Aizawa to transmit data to a base device using an optical communication link, Patent Owner asserts "Aizawa ***already*** includes a wireless transmitter . . . so Aizawa does not need to incorporate Inokawa's base device [optical] data transmission arrangement." PO Resp. 36–37 (citing Ex. 1006 ¶¶ 23, 28, 35); Ex. 2004 ¶¶ 85–86. Indeed, Patent Owner argues "Dr. Kenny acknowledged Aizawa does not indicate there are any problems with Aizawa's form of data transmission." PO Resp. 37 (citing Ex. 2007, 409:13–410:2). Patent Owner further contends "Aizawa's goal is to address problems associated with ***real-time*** measurement of heart rate," where Patent Owner argues the proposed combination would "***eliminate***[] the ability to take and display ***real-time*** measurements, one of Aizawa's stated goals." PO Resp. 37–39 (citing Ex. 1006 ¶¶ 4, 15; Ex. 1003 ¶ 101; Ex. 2007, 402:6–11, 405:2–7,

416:5–15; Ex. 2009, 393:6–14; Ex. 2011 ¶ 69 [sic 75]); Tr. 43:7–21 (also citing Ex. 1006 ¶ 6); Ex. 2004 ¶ 86. Patent Owner insists Inokawa does not aid Petitioner's case, because Inokawa discloses the benefits of using a second emitter in only two situations, to improve over a "cable" communication or "to avoid the use of a 'dedicated wireless communication circuit,'" whereas "Aizawa ***already*** uses wireless transmission." PO Resp. 38 (citing Ex. 1008 ¶ 4); Ex. 2004 ¶ 87.

Patent Owner accuses Petitioner and Dr. Kenny of overlooking further complications that would ensue from modifying Aizawa to have two emitters of different wavelengths. Patent Owner contends this would further increase power consumption and cost. *See* PO Resp. 38 (citing Ex. 2009, 381:18–382:8, 383:22–385:9, 390:5–392:3); Ex. 2004 ¶ 88. Further according to Patent Owner, Dr. Kenny overlooks how placing "two LEDs in close proximity may cause thermal interference that could create significant issues for sensor performance," and would require "structural changes" to Aizawa's configuration. PO Resp. 39–40 (citing Ex. 2012, 59–60; Ex. 2007, 379:17–21, 384:16–388:16, 389:17–390:20, 394:11–395:22); Ex. 2004 ¶ 88.

(iii) Petitioner's Reply

Concerning Petitioner's first motivation, and in response to Patent Owner's reliance on Aizawa's disclosure of "a device for computing the amount of motion load from the pulse rate" (Ex. 1006 ¶ 15), Petitioner asserts Patent Owner "fails to explain—and Aizawa itself is certainly silent—regarding how Aizawa senses and computes motion load." Pet. Reply 21; Ex. 1047 ¶ 46. Petitioner also contends Aizawa "is silent on whether it uses the computed motion load *to improve the detection signal*"

and thereby provide a "*more reliable*" pulse reading, which is Petitioner's asserted improvement to Aizawa. *Id.* (emphases added) (citing Pet. 17; Ex. 1003 ¶ 77; Ex. 2007, 401:11–402:4); Ex. 1047 ¶¶ 46–47.

Concerning Petitioner's second motivation, Petitioner maintains that Inokawa's use of two emitters having different wavelengths to upload data to a base station using optical communication advantageously improves the accuracy of the transmission by providing checksum information. Pet. Reply 22–23 (citing Pet. 20–21; Ex. 1003 ¶ 83; Ex. 1008 ¶¶ 11, 44, 48; Ex. 2007, 407:7–408:20, 416:5–15); Ex. 1047 ¶ 48.

As to the "other complications" that Patent Owner alleges would result from the proposed modification, Petitioner asserts "such minor issues are 'part of what [a POSITA] would bring . . . to the problem and would know how to make the changes needed.'" Pet. Reply 23 (quoting Ex. 2007, 384:8–388:12); Ex. 1047 ¶ 49.

(iv) Patent Owner's Sur-reply

Concerning Petitioner's first motivation, Patent Owner asserts Inokawa's disclosure is just as sparse as Aizawa's disclosure regarding how to use optical data to measure body movement. Sur-reply 15 (citing Ex. 1008 ¶ 59). Patent Owner also asserts "Petitioner cites nothing in Inokawa that suggests" Inokawa's two emitter data gathering is more reliable or otherwise superior to Aizawa's single emitter data gathering. *Id.* at 15–16.

Patent Owner also faults Petitioner for not specifying how a POSITA would have solved the alleged "additional cost, energy use, and thermal

problems" that would ensue from using two emitters in the Aizawa device. *Id.* at 17.

(v) Analysis and Conclusion

Upon review of the foregoing, we conclude a preponderance of the evidence supports Petitioner's contention that a POSITA would have been motivated to replace Aizawa's single near infrared LED 21, with an infrared LED and a green LED, in light of Inokawa, with a reasonable expectation of success.

First, a POSITA would have been motivated to make this replacement to improve the pulse measurements recorded by Aizawa's detector 1. Inokawa teaches that the infrared LED's signal can be used "to detect vital signs" such as "body motion," and the green LED's signal can be "used to detect pulse." Ex. 1008, Fig. 2, ¶¶ 14, 58–59; Ex. 1003 ¶¶ 60, 75–77; Ex. 1047 ¶¶ 45–47.

Patent Owner correctly points out that Aizawa describes its single-emitter detector 1 as transmitting its pulse data to "a device for computing the amount of motion load from the pulse rate." Ex. 1006 ¶¶ 15, 28, 35. But, this description is the only disclosure in Aizawa cited by Patent Owner as relating to computing a motion characteristic of the user. Further, we are unable to discern any other disclosure in Aizawa relating to motion computation, or what Aizawa proposes to do with its motion computation. *See id.* Based on the sparse nature of Aizawa's disclosure concerning motion load, it is not clear exactly what Aizawa proposes to do with the computed motion load, after it is computed. *See, e.g.*, Ex. 1047 ¶ 46 ("Aizawa does not even say whether it uses the computed motion load to

improve the detection signal[.]"). Aizawa does, however, describe the motion load as being computed "from the pulse rate," rather than being an input to the pulse rate calculation. Ex. 1006 ¶¶ 15, 35.

Dr. Kenny, when asked whether it was his understanding that "Aizawa's sensor could not account for motion load?", answered that "Aizawa's sensor attempts to prevent motion load rather than account for it." Ex. 2007, 400:7–11. He explained that, because Aizawa uses only a single emitter with a single wavelength, "what [Aizawa] sees as a signal would be some mixture of pulse rate and motion load if there was no effort to prevent motion load," so Aizawa seeks to solve the problem of "prevent[ing] motion load from corrupting the pulse rate signal." *Id.* at 400:12–401:10. Dr. Kenny did not further explain this distinction between preventing and accounting for motion load, in his deposition testimony cited by the parties as relating to this issue. *Id.* at 400:7–402:4. We do not rely on this distinction as a basis for our present decision, because we find no express support for it in Aizawa's disclosure (*see* Ex. 1006 ¶¶ 15, 28, 35), and it is not explained in persuasive detail by Dr. Kenny.

We nonetheless credit Dr. Kenny's declaration testimony that a POSITA, upon reviewing Inokawa' s disclosure of using two emitters of different wavelengths to calculate a user's pulse and motion separately, would understand that these two separate measurements would enable the device to calculate a "more reliable" pulse rate "that can . . . take into account and correct for inaccurate [pulse] readings related to body movement," by subtracting the signal component corresponding to body movement from the pulse signal "to help better isolate the desired pulse data." Ex. 1003 ¶ 77; Ex. 1047 ¶ 46. Aizawa does not disclose using the

computed motion load in this specific fashion, so it appears that this would improve upon the accuracy of Aizawa's pulse measurements, by using the computed motion load. *See* Ex. 1006 ¶¶ 15, 28, 35.

Dr. Madisetti also offers no meaningful opposing testimony in this regard. *See, e.g.*, Ex. 2004 ¶ 84. Instead, Dr. Madisetti incorrectly reads Dr. Kenny's motivation testimony as being limited to the desirability of adding the bare ability to measure body movement to Aizawa. *See id.* In fact, Dr. Kenny further testified that it would have been beneficial to *use* the measured body movement to *improve* the pulse measurement of the device. *See* Ex. 1003 ¶ 77. Dr. Madisetti does not address that testimony. *See* Ex. 2004 ¶ 84.

Dr. Kenny cites Exhibit 1010 in support of his motivation testimony in this regard. *See* Ex. 1003 ¶ 77 (citing Ex. 1010, 8:45–50). However, as we stated in the Institution Decision, "the cited passage [of Exhibit 1010] appears to discuss only a single light emitting element, so it provides very little (if any) support for the testimony in paragraph 77 of Dr. Kenny's Declaration [Ex. 1003 ¶ 77]." Inst. Dec. 17 n.5. Patent Owner notes this in the Sur-reply (at pages 16–17), but neither Dr. Kenny nor Dr. Madisetti further addresses whether or how Exhibit 1010 might bear upon Dr. Kenny's testimony in paragraph 77 of his declaration.

Nonetheless, because Dr. Madisetti's testimony sets up a straw man to attack, rather than directly addressing the entirety of Dr. Kenny's testimony in this regard, Dr. Kenny's testimony stands unrebutted in the record before us. Dr. Kenny's testimony also makes intuitive sense that measuring the user's motion *separately* from the user's pulse, for example by using two interrogating emitters of two different wavelengths, would provide a reliable

means of correcting the pulse data for motion artifacts by using the separately measured motion data, rather than by trying to segregate these two components in the single data stream provided by Aizawa's single emitter device. *See, e.g.*, Ex. 1047 ¶ 47. We, therefore, are persuaded by Dr. Kenny's unrebutted testimony that using two emitters of different wavelengths would improve Aizawa's device in this way.

Also, and independently, a POSITA would have been motivated to replace Aizawa's single near infrared LED 21, with an infrared LED and a green LED, to provide a reliable method of uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for display to the user. Inokawa expressly touts such optically-based uploading of data from Inokawa's wrist-worn sensor 1 to Inokawa's base station 17 as a benefit of incorporating two emitters in sensor 1. *See* Ex. 1008, Figs. 3 & 19, ¶¶ 3–7, 14, 76–77, 109–111. Inokawa identifies two specific benefits of this optically-based data communication means. First, the infrared LED can transmit the pulse data, and the green LED can separately transmit "checksum" information to increase the accuracy of data transmission. *Id.* at Fig. 19, ¶¶ 14, 109–111. Second, using light emitters in this fashion to perform two functions (data collection by emitting light into the user's wrist, and data transmission by emitting light to photodetectors in a base station) obviates the need for providing "a special wireless communication circuit [in the wrist-worn sensor 1] or a communication cable." *Id.* ¶¶ 3–7, 76–77.

Patent Owner points out correctly that Aizawa already has a "transmitter" 4 for uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for processing and for display to the user. Ex. 1006, Fig. 1(b), ¶¶ 15, 23, 28, 35. However, Aizawa's Figure 1(b)

illustrates transmitter 4 only as an empty box contained within outer casing 5, and Aizawa's written description does not provide further structural details concerning transmitter 4. *See id.* In particular, Aizawa does not describe exactly how transmitter 4 transmits its data to another device. *See id.*

Patent Owner contends, and Dr. Madisetti and Dr. Kenny both testify, that Aizawa's transmitter 4 is a "wireless" transmitter. *See, e.g.*, PO Resp. 37; Ex. 2004 ¶¶ 86–87; Ex. 2007, 403:17–22, 414:19–21. They all appear to equate "wireless" communication to radio frequency communication, and not to include optical communication, even though both radio frequency and optical communication do not use a wire. *See, e.g.*, PO Resp. 37; Ex. 2004 ¶¶ 86–87. Petitioner disagrees that Aizawa discloses any specific form of data transmission, including wireless transmission. *See* Tr. 71:5–72:3 ("[T]he transmitter disclosure in Aizawa, they don't say its's a wireless transmitter. That was a conjuration by [Patent Owner]. They don't specify whether it's a wired or wireless."). We assume, for this Decision, that Aizawa expressly contemplates radio frequency communication as one embodiment by which transmitter 4 may transmit data to devices other than detector 1.

Patent Owner argues, and Dr. Madisetti testifies, that Aizawa's express disclosure goes even further. They assert Aizawa's "goal" is to measure and display pulse data *in real time during exercise*, using the wireless transmitter. *See, e.g.*, Ex. 2004 ¶¶ 86–87. We find Aizawa does not support this assertion. Instead, Aizawa discusses prior art devices that "estimat[e] a burden on the heart of a person who takes exercise by *real-time measuring* his/her heart rate at the time of exercise" (Ex. 1006 ¶ 4 (emphasis

added)), and then describes Aizawa's detector 1 as having a transmitter for transmitting the measured pulse rate data to another device for display (*id.* ¶ 15). Aizawa also refers to "noise caused by the shaking of the body of the subject" as a problem to be addressed (*id.* ¶ 6), but this problem occurs regardless of whether the shaking results from exercise or the normal movement of the user's wrist over the course of the day. Thus, Aizawa does not tout, as an important feature of Aizawa's invention, the *real time display* of pulse rate data during exercise, regardless of whether the data gathered by Aizawa's wrist-worn detector 1 is transmitted wirelessly or otherwise. *Id.* ¶¶ 4, 6, 15.

No doubt, a POSITA would have viewed the capability of a wrist-worn pulse detector to transmit its pulse data to another device for display in real time while the user is exercising to be a desirable feature in some cases, even if this is not one of Aizawa's specific goals. *See, e.g.*, Ex. 2011 ¶ 75 (Dr. Kenny stating: "By wirelessly transmitting the collected data wirelessly, Mendelson 2006's system provides 'numerous advantages,' . . . ."); Ex. 2009, 393:6–14 (Dr. Kenny agreeing that a POSITA "would have seen the ability to wirelessly transmit collected data as an advantage"). Nonetheless, Inokawa expressly discloses that, in other cases, the benefits achieved thereby can be outweighed by obviating the need for the wrist-worn sensor to include a special wireless communication circuit. *See* Ex. 1008 ¶¶ 3–7, 76–77. We therefore conclude Petitioner's case for obviousness in this regard is supported by a preponderance of the evidence. *See, e.g.*, *In re Urbanski*, 809 F.3d 1237, 1243–44 (Fed. Cir. 2016) (persons of ordinary skill in the art may be motivated to pursue

desirable properties of one prior art reference, even at the expense of foregoing a benefit taught by another prior art reference).

We are not persuaded by Patent Owner's argument that Petitioner's case for obviousness is deficient on the basis that neither Aizawa nor Inokawa expressly discloses a wrist-worn sensor device that has *both* a plurality of emitters *and* at least four detectors, as claim 1 recites. Obviousness does not require "'some motivation or suggestion to combine the prior art teachings' [to] be found in the prior art." *KSR*, 550 U.S. at 407, 415–418. Nor does it require the bodily incorporation of Inokawa's device into Aizawa's device. *See, e.g., In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (test for obviousness is not whether the features of one reference may be bodily incorporated into the structure of the other reference, but rather is "what the combined teachings of the references would have suggested to those of ordinary skill in the art"); *see also In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) (nonobviousness is not established by attacking references individually when unpatentability is predicated upon a combination of prior art disclosures). Instead, "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton," and "in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle." *KSR*, 550 U.S. at 420–421.

In this case, a POSITA would have been motivated to modify Aizawa's wrist-worn detector 1 to replace its single near infrared LED 21 with an infrared LED and a green LED, based on Inokawa, and for all the reasons provided above. A POSITA would additionally have known to keep all four detectors 22 that are already present in Aizawa's detector 1, so that

"[e]ven when the attachment position of the sensor is dislocated, a pulse wave can be detected accurately," as disclosed by Aizawa. Ex. 1006 ¶¶ 9, 27. In short, the combination of Aizawa and Inokawa teaches that having multiple emitters is beneficial, and having multiple detectors is beneficial, for different and not inconsistent reasons.

Finally, we agree with Petitioner's position that the thermal interference and power consumption issues that will arise in Aizawa's wrist-worn pulse detector, by using two emitters instead of one emitter, are well within the capabilities of POSITA to solve. We credit Dr. Kenny's testimony in this regard. *See* Ex. 1003 ¶¶ 74–78, 85; Ex. 1047 ¶ 49. For example, Dr. Kenny acknowledges this modification of Aizawa may possibly "lead to increased power consumption," but nonetheless concludes "a POSITA would have known how to make the changes needed, for example concerning circuitry, to add another LED," because "Aizawa already contemplates adding additional emitters." Ex. 1003 ¶¶ 77–78 (citing Ex. 2006 ¶ 32 (sic ¶ 33)). Dr. Kenny further testifies that this modification "amount[s] to nothing more than the use of a known technique [i.e., Inokawa's use of two emitters in a wrist-worn pulse detector] to improve similar devices [i.e., Aizawa's wrist-worn pulse detector] in the same way, and combining prior art elements according to known methods to yield predictable results." *Id.* ¶¶ 79, 85 (citing Ex. 1015, 168, Fig. 2A).

Patent Owner cites several portions of Dr. Kenny's deposition testimony that, in Patent Owner's view, indicate Dr. Kenny fails to appreciate the significance of the thermal effects, optical interference complications, and power consumption needs, that are posed by adding a second emitter to Aizawa's device, and fails to explain how these issues

would have been overcome. *See* PO Resp. 38, 39–40 (citing Ex. 2007, 379:17–21, 384:8–388:16, 389:17–390:20, 394:11–395:22; Ex. 2009, 381:18–382:8, 383:22–385:9, 390:5–392:3). We have reviewed this deposition testimony, and we conclude Patent Owner overstates its significance. It establishes, at most, that Dr. Kenny did not expressly address these issues in his declaration (Exhibit 1003), but Dr. Kenny's opinion is that these issues would have been within the capability of a POSITA to resolve. Based on the evidentiary record presented to us, we agree with Dr. Kenny's opinion. For example, Inokawa discloses a wrist-worn pulse sensor 1 having two emitters 21 and 23 in close proximity to each other, and Mendelson-1988 discloses an "optical sensor of a pulse oximeter [that] consists of a red and an infrared light emitting diode[s]" as 0.3 x. 0.3 millimeter chips disposed within a few millimeters of each other. *See* Ex. 1008, Figs. 1–2; Ex. 1015, 168, Figs. 2A–2C.

Dr. Madisetti's testimony opposing Dr. Kenny's foregoing opinion is premised solely on Dr. Kenny's alleged failure to explain how the issues that arise from adding a second emitter to Aizawa would have been solved; Dr. Madisetti does not provide any affirmative reason why these issues would have been difficult to solve in the context of Aizawa's device or wrist-worn pulse sensing devices in general. *See* Ex. 2004 ¶ 88. For example, Dr. Madisetti cites Exhibit 2012[5] as "discussing power and thermal considerations," and cites the '265 patent as disclosing "using a thermistor and heat sinks and adjusting for temperature drift in the measurements." Ex. 2004 ¶ 88 (citing Ex. 2012, 59–60; Ex. 1001, 29:22–24). But,

[5] *Design of Pulse Oximeters* (J.G. Webster ed., 1997).

Dr. Madisetti does not explain why these issues would have been difficult to overcome. *See id.* Indeed, Exhibit 2012 discusses power consumption and heat generation of LED emitters in portable units as routine design considerations, rather than difficult problems. *See* Ex. 2012, 59–60. The ’265 patent is to a similar effect. *See* Ex. 1001, Fig. 11A, 29:16–42.

Thus, we conclude a POSITA would have been motivated to replace Aizawa’s single near infrared LED 21, with an infrared LED and a green LED, and would have had a reasonable expectation of success in doing so.

(2) Cover Comprising Protrusion

(i) Petitioner’s Contentions

Petitioner asserts that, although Aizawa indicates its transparent plate 6 helps to improve detection efficiency, “Aizawa does not provide much other detail” regarding plate 6, “for instance regarding its shape.”[6] Pet. 13, 28 (citing Ex. 1006 ¶ 30). Petitioner contends a POSITA nonetheless would have known how to give plate 6 a shape to improve detection efficiency. *Id.* (citing Ex. 1006 ¶¶ 13, 30, 32); Ex. 1003 ¶¶ 92–94.

According to Petitioner: “A POSITA would have looked to Inokawa to enhance light collection efficiency” in Aizawa’s plate 6, for example by “includ[ing] a convex protrusion that acts as a lens” like Inokawa’s lens 27. Pet. 14, 28–29 (citing Ex. 1008, Fig. 2); Ex. 1003 ¶¶ 95–97. Petitioner cites Inokawa’s description of lens 27 as “mak[ing] it possible to increase the light-gathering ability of the LED.” Pet. 14 (quoting Ex. 1008 ¶ 15);

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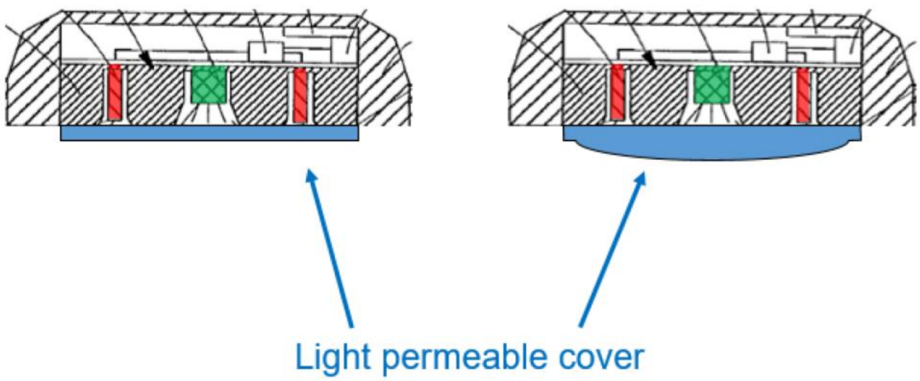
[6] Petitioner overstates the paucity of Aizawa’s disclosure here. Aizawa illustrates plate 6 as having a flat surface, which Dr. Kenny notes in his testimony. *See* Ex. 1006, Fig. 1(b); Ex. 1003 ¶¶ 93–94, 97.

Ex. 1003 ¶ 96. In particular, Dr. Kenny testifies a POSITA would have known that adding a convex protrusion to Aizawa's plate 6 would "increase light collection efficiency, in turn leading to an enhanced signal-to-noise ratio and ultimately more reliable pulse wave detection . . . by refracting and concentrating the light." Ex. 1003 ¶¶ 96–97; Pet. 14.

Dr. Kenny provides the following illustrations to portray the proposed modification of Aizawa's pulse rate detector 1. *See* Pet. 15; Ex. 1003 ¶ 97.



At the left, Dr. Kenny has excerpted and annotated Aizawa's Figure 1(b), to identify Aizawa's pre-existing cover (colored blue) which covers the light emitter (colored green) and the light detectors (colored red). *See* Ex. 1003 ¶ 97. At the right, Dr. Kenny has illustrated the device resulting from the proposed modification of the cover to have a convex protrusion (colored blue). *See id.* Dr. Kenny testifies that this modification would increase the light-gathering ability of Aizawa's four detectors 22, because "the modified cover will allow more light to be gathered and refracted toward the light receiving cavities [23b] of Aizawa . . . beyond what is achieved through the tapered cavities [23b]." *Id.* (citing Ex. 1008 ¶ 15); Pet. 14–15.

Further according to Petitioner: "A POSITA would have understood how to implement Inokawa's lens-shaped cover in Aizawa's device with a reasonable expectation of success." Pet. 15–16 (citing Ex. 1008, Figs. 16

& 17, ¶¶ 15, 106); Ex. 1003 ¶ 98. Petitioner adds that Aizawa's "transparent acrylic material . . . can be readily formed into a lens-like shape as in Inokawa." Pet. 16 (citing Ex. 1023, Fig. 6, ¶¶ 22, 32, 35); Ex. 1003 ¶ 99. The shape of the modified cover in Dr. Kenny's illustration of the proposed modification above is strikingly similar to the shape of an LED lens unit illustrated in Exhibit 2023[7] (hereafter "Nishikawa"), cited by Petitioner in connection with reasonable expectation of success. *Compare* Pet. 15 (illustrating proposed modification), *with* Ex. 2023, Fig. 6, ¶¶ 3, 22, 30, 32, 35 (illustrating lens unit 50 used with LED 22, and discussing how to make the illustrated device).

(ii) Patent Owner's Contentions

Patent Owner contends the evidence does not support Petitioner's argument that a POSITA would have been motivated to modify Aizawa's cover 6 to have a convex protrusion, in order to improve detection efficiency by directing incoming light to Aizawa's photodetectors 22, with a reasonable expectation of success. *See* PO Resp. 1–4, 11–34; Ex. 2004 ¶¶ 39–78.

According to Patent Owner, the evidence establishes Petitioner's proposed modification would direct light *toward the center* of Aizawa's detector 1 where emitter(s) 21 are located, rather than *toward the periphery* where detectors 22 are located. PO Resp. 13–18; Ex. 2004 ¶¶ 42–58. Thus, Patent Owner's view is that "a POSITA would ***not*** have expected Inokawa's convex surface to accomplish" the objective of enhancing light collection efficiency relied upon by Petitioner, because Petitioner's proposed modification instead "would direct light ***away*** from the ***periphery***-located

[7] US 2007/0145255 A1, published June 28, 2007.

detectors" in Aizawa, the opposite result to Petitioner's contention. PO Resp. 18–19; Ex. 2004 ¶¶ 56–58.

In support, Patent Owner points to Inokawa's Figure 2, in which two arrows illustrate light that passes through the convex protrusion of lens 27 toward the center of Inokawa's pulse sensor 1 where detector 25 is located. PO Resp. 13, 16 (citing Ex. 1008 ¶ 58); Ex. 2004 ¶¶ 42–43, 51–52. Patent Owner also points to the '265 patent's Figure 14B, which illustrates several light rays 1420, 1422 passing through a partially cylindrical protrusion 605 to be centrally focused on detector(s) 1410B. PO Resp. 17 (citing Ex. 1001, 36:11–14, 36:21–23); Ex. 2004 ¶¶ 53–54. Patent Owner cites portions of Dr. Kenny's deposition testimony that, in Patent Owner's view, support Patent Owner's contentions in these regards. *See* PO Resp. 2, 16, 17, 22 (citing Ex. 2006, 83:15–84:2, 86:19–87:1, 202:11–204:20).

Patent Owner also asserts "Dr. Kenny admitted that the impact of Inokawa's convex lens would not be 'obvious' in the context of [the] different configuration of LEDs and detectors" presented by Aizawa. PO Resp. 19 (citing Ex. 2006, 87:2–6). For example, Patent Owner points out that "light reaching Aizawa's detectors must travel in an opposite direction from the light in Inokawa." *Id.* at 19–20 (citing Ex. 1006, Fig. 1(b); Ex. 1008, Fig. 2); Ex. 2004 ¶¶ 59–62. In addition, according to Patent Owner, "Petitioner's combination is particularly problematic because" Aizawa uses "small detectors [22] with small openings [of cavities 23c] surrounded by a ***large*** amount of ***opaque*** material." PO Resp. 20 (citing Ex. 1006, Fig. 1(a)); Ex. 2004 ¶ 63. Patent Owner cites portions of Dr. Kenny's deposition testimony that, in Patent Owner's view,

support Patent Owner's contentions in these regards. *See* PO Resp. 20–21 (citing Ex. 2006, 257:11–18).

Patent Owner asserts that Petitioner's illustration of the light-focusing properties of a convex protrusion lens, when discussing dependent claim 12, (*see* Pet. 38–39) "***drastically*** increases the size of the detectors compared to Aizawa and ***eliminates*** surrounding barriers" that are present in Aizawa, which when properly taken into account "confirms the light ***would not even reach***" Aizawa's peripheral detectors 22 if a convex lens were applied. *See* PO Resp. 21–22 (citing Ex. 1006, Fig. 1(b)); Ex. 2004 ¶¶ 64–65.

Patent Owner argues further that Dr. Kenny, during his deposition, attempted to evade the foregoing problems with his declaration testimony by "disclaim[ing] Petitioner's reasoning [for obviousness] and assert[ing] new and improper opinions" that undermine the reasoning provided in the Petition. PO Resp. 2, 22–23 (citing Ex. 1003 ¶¶ 97, 119, 200; Ex. 2006, 65:15–70:7, 108:21–109:14, 198:6–16; Ex. 2009, 310:1–20); Ex. 2004 ¶ 66. For example, Patent Owner asserts Dr. Kenny's attempt to distinguish between the '265 patent's Figure 14B as illustrating a lens that condenses *collimated* light toward the center, and Aizawa and Inokawa in which the lens focuses *diffuse* light reflected by the user's body, is not persuasive and is not supported by any evidence. PO Resp. 23–24 (citing Ex. 2006, 170:9–171:5; Ex. 2007, 288:13–289:5, 294:17–298:10, 298:11–299:18, 423:7–424:18); Ex. 2004 ¶¶ 67–68. Patent Owner also objects to Dr. Kenny's testimony that, "while a convex lens would generally direct more light to the center," it "would also capture some light that otherwise would not be captured" by Aizawa's detectors 22, as lacking evidentiary support other than in the '265 patent itself which is impermissible hindsight.

PO Resp. 24–25 (citing Ex. 2006, 204:21–206:5, 206:22–208:1; Ex. 2007, 294:17–298:10; Ex. 1001, 7:61–63); Ex. 2004 ¶¶ 69–70. Patent Owner moreover asserts "Dr. Kenny repeatedly distanced himself from his own combination" of Aizawa and Inokawa by refusing to talk about the specific shape, size, material, and dimensional tolerances of the combination, so his testimony falls short because it demonstrates at most only that the references could have been combined. PO Resp. 2–3, 25–28 (citing Ex. 1003 ¶ 111; Ex. 2006, 51:14–52:16, 75:20–77:2, 91:9–92:13, 96:20–21, 97:11–21, 100:17–101:18, 132:10–18, 154:4–7, 164:8–16, 189:11–190:3; Ex. 2007, 308:12–309:8, 310:18–311:9, 318:3–6, 324:21–325:19, 333:20–335:4); Ex. 2004 ¶¶ 71–72.

Indeed, according to Patent Owner, because ordinary skill does not require specific education or experience with optics or optical physiological monitors (*see supra* Section III.B): "It strains credibility that a POSITA . . . could balance all of the factors Dr. Kenny identified" as affecting the performance of a protruding convex lens in an optical physiological sensor to reach the claimed invention. PO Resp. 28–29 (citing Ex. 2006, 51:21–52:16, 93:16–94:15, 100:17–101:18; Ex. 2009, 347:14–352:18); Ex. 2004 ¶¶ 73–75. Patent Owner relies on Dr. Kenny's testimony, as establishing the complexity of designing optical physiological sensors. PO Resp. 3–4, 29–30 (citing Ex. 2006, 86:19–87:6; Ex. 2007, 331:19–332:11, 336:11–337:15). Patent Owner concludes Petitioner has failed to establish a reasonable expectation of success in reaching the invention of claim 1 based on Aizawa and Inokawa, because Dr. Kenny's testimony on this issue "focuses almost entirely on manufacturing." *Id.* at 30 (citing Ex. 1003 ¶ 99); Ex. 2004 ¶ 75.

Patent Owner moreover asserts Petitioner errs in relying on Nishikawa as supporting the unpatentability of claim 1, because Nishikawa is "not identified as part of" Ground 1A, which instead "includes only two references," Aizawa and Inokawa. PO Resp. 31 (citing Pet. 1–2, 28; Ex. 1003 ¶¶ 94–99); *id.* at 32–33 (citing 35 U.S.C. § 312(a)(3); *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016)). Patent Owner asserts Dr. Kenny "relies heavily on" Nishikawa, particularly "to inform the specific shape of the cover in his combination, which is found nowhere in Aizawa and Inokawa." *Id.* at 31–32 (citing Pet. 28–29; Ex. 2006, 179:21–180:13; Ex. 2007, 364:2–13; Ex. 2008, 73:8–12); Ex. 2004 ¶¶ 76–77.

Further, in Patent Owner's view, Dr. Kenny's reliance on Nishikawa "make[s] no sense" because "Nishikawa's device is not a physiological sensor" but rather is "an encapsulated LED" that "directs ***outgoing*** light through the encapsulation material and thus focuses on the emission of light, not the detection of an optical signal." PO Resp. 33 (citing Ex. 1023, code (57), ¶¶ 3, 32, 35); Ex. 2004 ¶ 78. Patent Owner contrasts such disclosure with Aizawa and Inokawa, both of which "detect[] ***incoming*** light that passes through the cover and reaches the detectors," and which have a "drastically" smaller scale than Nishikawa's LEDs. PO Resp. 33–34 (citing Ex. 1008, Fig. 2); Ex. 2004 ¶ 78.

(iii) Petitioner's Reply

In reply, Petitioner insists "Inokawa's lens enhances the light-gathering ability of Aizawa," which would have motivated a POSITA "to incorporate 'an Inokawa-like lens [having a convex protrusion] into the

cover of Aizawa to increase the light collection efficiency.'" Pet. Reply 2–3 (bolding omitted) (citing Pet. 14–15, 28; Ex. 1003 ¶¶ 94–99; Ex. 1008, Fig. 2, ¶¶ 15, 58). Petitioner dismisses Patent Owner's and Dr. Madisetti's opposition as being "misinformed" regarding Inokawa's lens and lenses in general, because "a POSITA would understand that Inokawa's lens improves 'light concentration at pretty much all of the locations under the curvature of the lens,' as opposed to only at a single point at the center." *Id.* at 3 (quoting Ex. 2006, 164:8–16); *id.* at 1, 3 (citing PO Resp. 13; Ex. 1041, 89:12–19; Ex. 1042, 170:12–20); Ex. 1047 ¶¶ 3–5, 19–23.

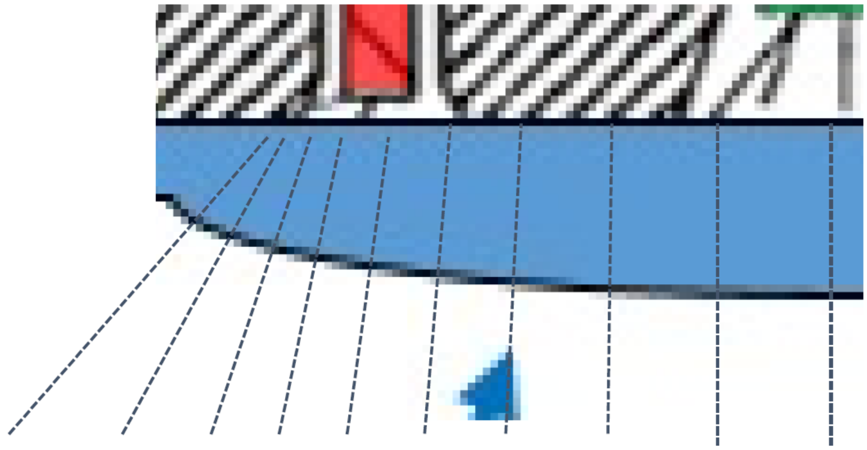
For example, Petitioner asserts Patent Owner and Dr. Madisetti "ignore[] the well-known principle of reversibility" according to Snell's law.[8] Pet. Reply 4–7 (underlining omitted) (citing Ex. 1040, 84, 87–92; Ex. 1043, 80:20–82:20; Ex. 1049, 101, 106–111); Ex. 1047 ¶¶ 32–39. Petitioner asserts Dr. Madisetti was evasive when he was asked to apply the reversibility principle to the combination of Aizawa and Inokawa in this case. Pet. Reply 6 (citing Ex. 1041, 89:12–19, 84:2–85:7).

Petitioner also asserts Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue in the user's wrist, to be received by detectors in either Aizawa's or Inokawa's pulse sensor, will be "scattered" and "diffuse" and therefore will approach the detectors "from various random directions and angles." Pet. Reply 7–8 (citing Ex. 1046, 803; Ex. 2012, 52, 86, 90); *id.* at 8–10 (annotating Inokawa's Fig. 2 to illustrate the cause and nature of the back-scattering); Ex. 1003 ¶ 128;

[8] Snell's law describes how a light ray will be refracted when passing between two mediums having different indices of refraction. *See* Ex. 1047 ¶ 10 (describing and illustrating Snell's law).

Ex. 1047 ¶¶ 6–9. This scattered and diffuse light, according to Petitioner, means that Inokawa's "lens cannot focus all incoming light at a single point" at a central location as Patent Owner would have it. Pet. Reply 7, 8–10 (citing Ex. 2006, 163:12–164:2); Ex. 1047 ¶¶ 6, 8, 11–13. Petitioner asserts this is due to Snell's law, and provides several illustrations to illustrate why. Pet. Reply 8–12 (citing Ex. 1040, 84; Ex. 1043, 80:20–82:20; Ex. 1049, 101; Ex. 2012, 52, 86, 90); Ex. 1047 ¶¶ 9–10, 14–16.

Due to the random nature of this scattered light, Petitioner asserts a POSITA would have understood that "Inokawa's lens provides at best a slight refracting effect, such that light rays that otherwise would have missed the detection area are instead directed toward that area as they pass through the interface provided by the lens." Pet. Reply 13; Ex. 1047 ¶ 18. Petitioner applies this understanding to Aizawa, and asserts that using a lens with a convex protrusion in Aizawa would "enable backscattered light to be detected within a circular active detection area surrounding" a central light source, thereby "allowing a larger fraction of the backscattered light to reach the areas covered by the lens" including the circular detection area. Pet. Reply 13–14 (citing Ex. 1046, 803; Ex. 2006, 164:8–16, 204:21–205:12; Ex. 2012, 86, 90); Ex. 1047 ¶ 18–22. Dr. Kenny provides the following illustration of this alleged effect. *See* Ex. 1047 ¶ 21; Pet. Reply 14.



Here, Dr. Kenny has excerpted a portion of his illustration of using a lens with a convex protrusion (in blue) on top of Aizawa's pulse rate detector (with a photodetector, in red) (*see* Ex. 1003 ¶ 97), and added several dotted lines that are orthogonal to the lens surface. Pet. Reply 14; Ex. 1047 ¶¶ 20–21. Dr. Kenny testifies that Snell's law indicates "the incoming light rays are refracted in a way that deflects incoming rays somewhat towards these orthogonal lines," and that because "these orthogonal lines vary in orientation most rapidly near the edge, where the illustrated curvature of the lens surface is the greatest," using this lens in Aizawa "would lead to an improvement in the light concentration at the location of the detectors." Ex. 1047 ¶¶ 21–22.

Petitioner additionally asserts a POSITA, upon reading Inokawa's disclosure that its lens 27 "makes it possible to increase the light-gathering ability of the LED" in an optically-based pulse sensor device (Ex. 1008 ¶ 15), would have understood that this "general benefit" could also be achieved within the context of Aizawa's optically-based pulse sensor device, and is not limited to "the exact" structure of Inokawa's device. Pet. Reply 15 (citing Ex. 1003 ¶¶ 61, 96–98; Ex. 2006, 88:21–89:1, 89:21–90:3); Ex. 1047 ¶ 23.

Petitioner asserts Dr. Madisetti's testimony in support of Patent Owner's position ignores the application of Snell's law to the random nature of backscattered light in the context of Aizawa's and Inokawa's pulse sensors, which measure light *reflected* (i.e., backscattered) by the user's tissue. Pet. Reply 12–13 (citing Ex. 1042, 166:12–182:3); Ex. 1047 ¶ 17. Petitioner similarly dismisses the applicability of Figure 14B of the '265 patent as illustrating the operation of a *transmittance*-type of sensor that measures the attenuation of collimated light transmitted through the user's body tissue, rather than the *reflectance*-type sensors of Aizawa and Inokawa. Pet. Reply 15–17 (citing Ex. 1001, 36:19–21, Fig. 14I; Ex. 2007, 287:12–289:5); Ex. 1047 ¶¶ 24–28.

Petitioner further disagrees with Patent Owner's argument that Petitioner's illustrations of the light-focusing properties of a convex lens when discussing dependent claim 12 (*see* Pet. 38–39) demonstrate "that a convex lens directs all light to the center." Pet. Reply 18–19 (citing PO Resp. 15, 21, 22; Ex. 1041, 41:7–22, 60:7–61:6). Petitioner contends these illustrations, instead, "are merely simplified diagrams included to illustrate . . . one example scenario (based on just one ray and one corpuscle) where a light permeable cover can 'reduce a mean path length of light traveling to the at least four detectors'" as recited in claim 12. *Id.* (citing Pet. 39; Ex. 1003 ¶¶ 119–120); Ex. 1047 ¶¶ 30–31.

(iv) Patent Owner's Sur-reply

Patent Owner asserts Petitioner's Reply improperly presents several new arguments, relying on new evidence, as compared with the Petition. *See, e.g.*, Sur-reply 3 n.3 (objecting to the illustration provided at Pet.

Reply 14 as being "new"); *id.* at 4–6 ("After recognizing the fundamental error in its proposed combination, Petitioner now attempts to rewrite its petition" concerning how a lens with a convex protrusion would focus light in Aizawa's device); *id.* at 7 ("Petitioner's new theory [concerning reversibility of light rays] is improper, denying [Patent Owner] of the opportunity to respond with expert testimony, and should be rejected."); *id.* at 10 ("Petitioner next asserts a number of other new theories found nowhere in the petition.").

Patent Owner also asserts Petitioner mischaracterizes Patent Owner's position, which is not that Inokawa's lens with a convex protrusion "direct[s] '***all***' light 'only at a ***single point*** at the center'" of the sensor as Petitioner characterizes it. Sur-reply 1–2 & n.1 (quoting Pet. Reply 3, and citing PO Resp. 2, 14–18, 23, 24, 27 and Ex. 2027, 63:7–64:6, 94:20–96:1, 96:18–97:7). Patent Owner's position, rather, is that Inokawa's lens condenses more light (not necessarily all light) "***towards the center***" (not necessarily at a single, central point) relative to Aizawa's flat cover. *Id.* at 2–3 (quoting PO Resp. 18, and citing Ex. 2004 ¶¶ 34, 43, 49, 51, 52, 54, 55, 67).

Patent Owner moreover asserts "[t]here can be no legitimate dispute that a convex surface directs light centrally (and away from the periphery)," so Petitioner errs in asserting that a POSITA would have used a convex lens with Aizawa's detector 1 to improve its light detection efficiency, because Aizawa's photodetectors 22 are disposed at the periphery of the device. *Id.* at 4–6 (citing Pet. 13–15, 39; PO Resp. 15–18; Ex. 1003 ¶¶ 97, 119, 200; Ex. 2006, 164:8–16, 166:10–17, 170:22–171:5; Ex. 2027, 181:9–182:5). Patent Owner contends Petitioner's argument "that Inokawa would improve

light-gathering at all locations, ***regardless*** of the location of the LEDs and detectors" is belied by Dr. Kenny's testimony that "Inokawa's benefit would ***not*** be clear if Inokawa's LEDs and detectors were moved" and "confirmed that a convex surface would direct light toward the center of the underlying sensor." Sur-reply 6–7 (citing Pet. Reply 3–4; Ex. 2006, 86:19–87:6, 202:11–204:20).

Patent Owner argues Petitioner's discussion of the principle of reversibility is "irrelevant" because it "assumes ideal conditions that are not present when tissue scatters and absorbs light." Sur-reply 7–9 (citing Ex. 1040, 88, 92, 399 (citations to the exhibit's page numbers modified to refer to the document's page numbers)); Ex. 2027, 17:12–19:2, 29:11–30:7, 31:8–32:3, 38:17–42:6, 207:9–209:21, 210:8–6). The random nature of backscattered light, in Patent Owner's view, "hardly supports Petitioner's argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed," and is irrelevant to the central issue presented here of "whether a convex surface—***as compared with a flat surface***—would collect and focus additional light on Aizawa's peripherally located detectors." Sur-reply 9–10 (citing Ex. 2006, 86:19–87:6; Ex. 2027, 212:3–14).

In response to Petitioner's argument that "due to its protruded shape, Inokawa's lens 'provides an opportunity to capture some light that would otherwise not be captured'" in Aizawa (Pet. Reply 14), Patent Owner asserts "Dr. Kenny was unable to support this new theory with any evidence." Sur-reply 10–11 (citing Ex. 2007, 294:17–298:10). Patent Owner further asserts Petitioner "fails to consider the greater ***decrease*** in light at the detectors due to light redirection to a ***more*** central location." *Id.* at 13

(citing Pet. Reply 20; Ex. 2027, 19:16–21:8). Patent Owner explains that "the circle of backscattered light's intensity '***decreases*** in direct proportion to the ***square of the distance*** between the photodetector and the LEDs,'" so "any purported signal obtained from light redirected from the sensor's ***edge*** would be relatively weak and fail to make up for the much greater loss of signal strength when light is redirected away from the detectors and towards a more central position." *Id.* (citing Ex. 1015, 2; Ex. 2027, 49:17–50:13, 57:10–22).

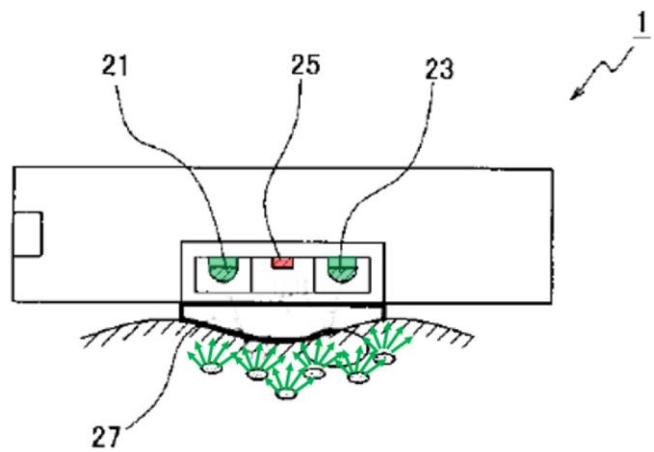
Patent Owner contends Petitioner's position concerning the '265 patent's Figure 14B is not supported by evidence. *Id.* at 11 (citing PO Resp. 15–17; Ex. 2007, 423:7–424:18).

(v) Analysis and Conclusion

Upon review of the foregoing, we conclude a preponderance of the evidence supports Petitioner's contention that a POSITA would have been motivated to modify Aizawa's cover 6 to include a convex protrusion, in light of Inokawa, in order to increase the amount of backscattered light that will be received by Aizawa's four peripheral detectors 22, versus Aizawa's existing flat cover 6.

We find Aizawa's and Inokawa's pulse sensors both gather data by emitting light into the user's wrist tissue, and collecting light that reflects back to the sensor from within the user's tissue. *See, e.g.*, Ex. 1006, Figs. 1(b) & 2 (sensor 2 has emitter 21 and four detectors 22, all facing a user's wrist 10); Ex. 1008, Figs. 1 & 2 (sensor 1 has two emitters 21, 23 and one detector 25, all facing the user's wrist when held in place by wristband 5). Dr. Kenny testifies, and Patent Owner agrees, that the

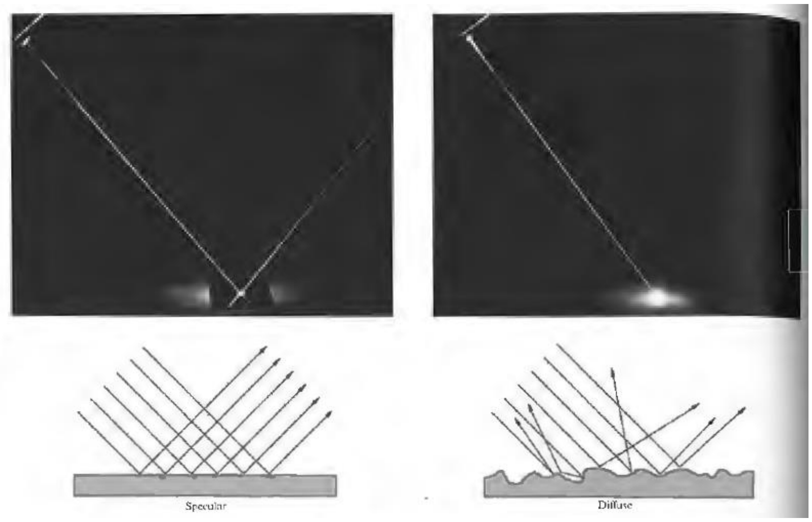
reflection of this light by the user's wrist tissue randomizes the propagation direction of the reflected light rays. *See* Ex. 1003 ¶ 128; Ex. 1047 ¶¶ 6–7; Sur-reply 7–8 ("Even Petitioner admits that tissue randomly scatters and absorbs light rays . . . ."); Tr. 65:23–66:13. This is illustrated by Dr. Kenny's annotations to Inokawa's Figure 2 (Ex. 1047 ¶¶ 6–7), reproduced below:



Here, Dr. Kenny has modified Inokawa's Figure 2 by removing two black arrows, by coloring Inokawa's light detector in red and Inokawa's two light emitters in green, and by adding several green arrows to illustrate the various directions that light rays may be directed after impinging on and reflecting off different tissues in the user's wrist. Ex. 1047 ¶¶ 6–7.

This randomized direction of reflected light rays results in backscattered light that is diffuse, rather than collimated, in nature. Exhibit 1040,[9] Figure 4.12, illustrates the difference between diffuse and collimated light, and is reproduced below:

[9] Eugene Hecht, *Optics* (2nd ed. 1990).

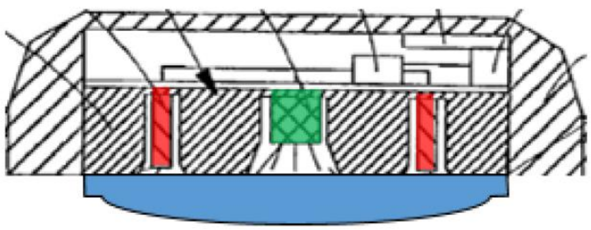


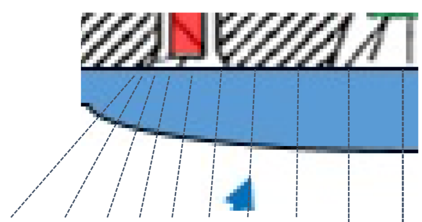
This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a photograph and an illustration of incoming collimated light reflecting from a rough surface. *See* Ex. 1040, 87–88. The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. *See id.* The rough surface provides diffuse reflection, in which the reflected light rays travel in random directions. *See id.*

This diffuse nature of the light reflected from the user's wrist tissue, which both Aizawa and Inokawa aim to collect to generate pulse data, suggests that a lens might be useful to increase the amount of collected light and thereby increase the reliability of the pulse data generated using the collected light. Indeed, this is taught by Inokawa. Inokawa describes using its lens 27 to "increase the light-gathering ability" of Inokawa's light detector 25. Ex. 1008 ¶¶ 15, 58. Inokawa actually refers to the "LED" such as emitters 21, 23 in this regard (*id.* ¶ 15), rather than detector 25, but it is undisputed that detector 25 is the only component of Inokawa's sensor 1 that gathers light. Thus, in a general sense, Inokawa demonstrates that it was known in the art prior to the '265 patent to use a lens to focus diffuse light

reflected from body tissue on to the light detecting elements of a wrist-worn pulse sensor, to increase the light gathered by the sensor and thereby improve the device's calculation of the user's pulse. Inokawa also discloses, in its Figure 2, that a convexly protruding lens may advantageously be used for this purpose.

A preponderance of the evidence supports Petitioner's contention that a POSITA would have been motivated to apply Inokawa's convex lens technology to Aizawa's wrist-worn pulse sensor, to improve its light collection in a similar manner versus Aizawa's existing flat cover. This is illustrated by the following illustrations provided by Dr. Kenny:

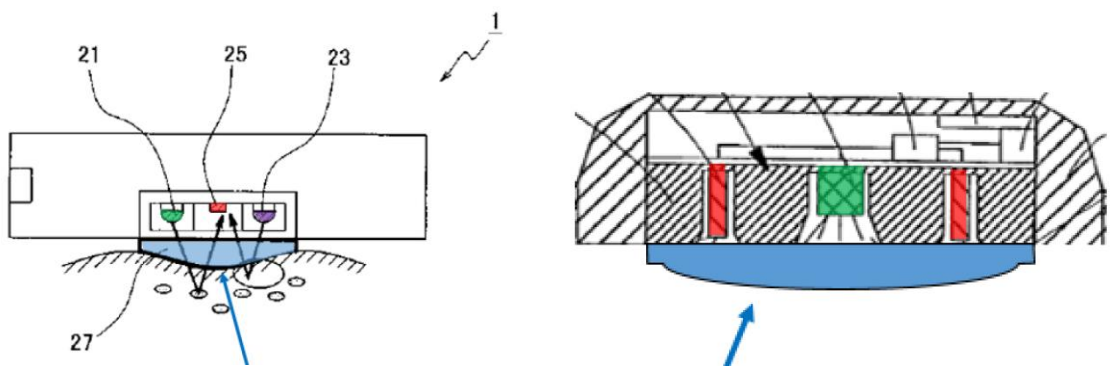




The illustration at left modifies Aizawa's Figure 1(b) to show how Aizawa's existing flat cover may be modified to incorporate a convex protrusion (in blue) to act as a light-focusing lens, which covers Aizawa's four peripheral light detectors (two shown in red) and central light emitter (colored green). *See* Ex. 1003 ¶ 97. The illustration at right zooms in on the portion of this modification covering one of the detectors, and adds several dotted lines that are orthogonal to the lens surface. *See* Ex. 1047 ¶¶ 20–21. We are persuaded by Dr. Kenny's testimony that Snell's law indicates "the incoming light rays are refracted in a way that deflects incoming rays somewhat towards these orthogonal lines," and that because "these orthogonal lines vary in orientation most rapidly near the edge, where the illustrated curvature of the lens surface is the greatest," using the illustrated

lens in Aizawa "would lead to an improvement in the light concentration at the location of the detectors." Ex. 1047 ¶¶ 18–22 (applying Snell's law to Aizawa); *id.* ¶¶ 8–17 (discussing Snell's law in the abstract).

Patent Owner correctly notes that Inokawa's single detector 25 is located in the central portion of Inokawa's sensor 1, whereas Aizawa's four detectors 22 are located more towards the periphery of Aizawa's sensor 2. *Compare* Ex. 1008, Fig. 2, *with* Ex. 1006, Figs. 1(a)–1(b). However, Petitioner's proposed modification of Aizawa takes this into account, as can be seen by the following comparison between Inokawa's sensor and Petitioner's proposed modification of Aizawa's sensor:



The illustration at left annotates Inokawa's Figure 2 to identify the central detector in red and the lens in light blue (*see* Ex. 1003 ¶ 95), and the illustration at right annotates Petitioner's proposed modification of Aizawa to illustrate the peripheral detectors in red and the lens in light blue (*see id.* ¶ 97). As can be seen, the lenses both utilize a convex protrusion, but the convex protrusions are not identical. In Inokawa the lens's curvature is most pronounced at the center of the lens near the central detector, and in the proposed modification to Aizawa, the lens's curvature is most pronounced at the edges of the lens near the peripheral detectors. Thus, Dr. Kenny's proposed modification of Aizawa takes Inokawa's general teaching of using

a convex protrusion lens to increase the amount of incoming light directed to a light detector, and applies it to the four light detectors of Aizawa. *See, e.g.*, Ex. 1003 ¶¶ 95–97; Ex. 1047 ¶¶ 8–22.

Patent Owner also correctly observes that Dr. Kenny borrowed, from Nishikawa, the specific shape of the convex lens in Petitioner's proposed modification of Aizawa. *See, e.g.*, PO Resp. 31–32 (citing Ex. 1003 ¶ 99; Ex. 2006, 179:21–180:13; Ex. 2007, 364:2–13; Ex. 2008, 73:8–12). However, we disagree with Patent Owner's assertion that this is improper on the basis that Nishikawa is not listed as a reference in Petitioner's identification of Ground 1A. *See* Pet. 1–2, 6 (identifying Ground 1A as obviousness over Aizawa and Inokawa). Rejecting Petitioner's reliance on Nishikawa on this basis would exalt form over substance, which we decline to do. The nature of Petitioner's reliance on Nishikawa in support of Ground 1A is explained clearly in the Petition, even if Nishikawa is not listed as a third reference in the identification of the ground. *See id.* at 16 (discussing Nishikawa (Ex. 1023) and Dr. Kenny's testimony concerning Nishikawa (Ex. 1003 ¶ 99) in connection with Ground 1A); *see also supra* Section III.D.3(c)(2)(i) & (iii) (summarizing Petitioner's contentions and evidence). Thus, the Petition complies with 35 U.S.C. § 312(a)(3) (stating an IPR petition must "identif[y], in writing and with particularity . . . the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge . . . ").

On the merits, the Petition discusses how Nishikawa indicates "the transparent acrylic material used to make Aizawa's plate can be readily formed into a lens-like shape as in Inokawa," with a reasonable expectation of success. Pet. 16 (citing Ex. 1023, Fig. 6, ¶¶ 22, 32, 35); Ex. 1003 ¶ 99.

Nishikawa supports this contention, because it describes how its "lens unit 50" can be a transparent resin formed in the shape illustrated in Figure 6 by injection molding. As to using Nishikawa's specific lens shape in the context of Aizawa's device, Dr. Kenny explains that Nishikawa's lens shape design "*is intended to provide curvature in the lens where it can do the most good* and otherwise try to avoid excess use of material in order to create curvature in locations where it wouldn't do any good." Ex. 2006, 179:21–180:13 (emphasis added). This makes sense and, as discussed above, a POSITA would have understood from Inokawa's disclosure that a lens's curvature does the most good in a wrist-worn sensor when it aligns with the light detectors behind the lens, to focus the incoming light on those detectors. This is true regardless of the fact that, as Patent Owner points out, Nishikawa's lens unit 50 redirects light *emitted from* LED 22, rather than redirecting light *gathered by* a detector such as Inokawa's detector 25 or Aizawa's detectors 22. *See* Ex. 1023, Fig. 6, ¶¶ 3, 22. Patent Owner's additional objection concerning the smaller scale of Aizawa's wrist-worn pulse sensor versus Nishikawa's lens unit 50 also is not persuasive of error in Petitioner's reliance on Nishikawa, given Inokawa's clear disclosure of using a lens in a wrist-worn pulse sensor like Aizawa's.

Figure 14B of the '265 patent also is consistent with Petitioner's proposed modification of Aizawa. Figure 14B is reproduced here:

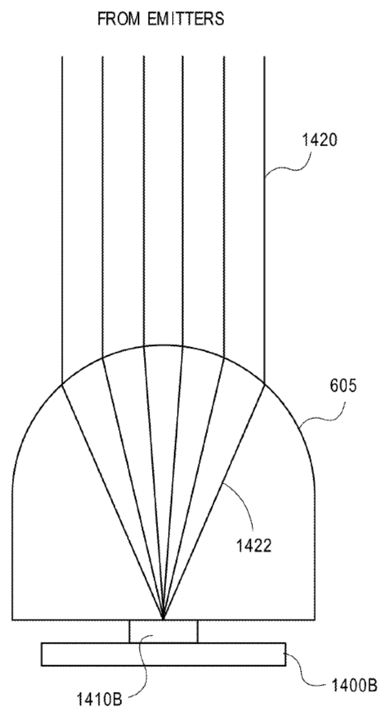


Figure 14B illustrates several light rays 1420, 1422 passing through a partially cylindrical protrusion 605 to be centrally focused on detector(s) 1410B. Ex. 1001, 36:11–14, 36:21–23. This is consistent with Dr. Kenny's testimony, discussed above, that a POSITA would have known how to align a lens's curvature with the light detector(s) underneath the lens to increase the amount of incoming light directed to the detector(s). In this specific regard, the '265 patent's Figure 14B is very similar to Inokawa's Figure 2. As discussed above, it would have been obvious to adapt a POSITA's understanding of Inokawa's teachings to the different detector configuration of Aizawa, leading to the invention recited in claim 1 without hindsight. *See, e.g.*, Ex. 2006, 202:11–20 (Dr. Kenny testifying that "because of its shape [a lens] is able to capture more light due to the convex shape, and *it's able to increase the concentration of the light directed towards the cavities [of Aizawa containing detectors 22] under the regions where the curvature of the lens is present*" (emphasis added)).

Patent Owner contends Petitioner's modification of Aizawa "fails to consider the greater ***decrease*** in light at the detectors due to light redirection to a ***more*** central location." Sur-reply 13 (citing Ex. 1015, 2; Ex. 2027, 19:16–21:8, 49:17–50:13, 57:10–22); Ex. 2004 ¶¶ 66–70. Dr. Kenny admits that, when a convex protrusion is added to Aizawa's flat cover in light of Inokawa, "*some* . . . [light] rays that would have hit the detectors [using a flat cover] are refracted away from the detectors" by the convex protrusion. *See* Ex. 2027, 19:16–20:8 (emphasis added). Dr. Kenny also admits "there is a decrease in the light as you move away from the location of the emitter towards the perimeter of the sensor," which is a "rapid" decrease, perhaps "with the square of the distance" or "exponential[ly]." *Id.* at 49:1–50:13, 57:10–22.

However, Dr. Kenny nonetheless maintains that a POSITA "would understand how to take advantage of the detector locations and the shape of this convex surface *so as to obtain an improvement [in Aizawa] in the amount of light arriving at the detectors*," despite the foregoing considerations. *Id.* at 20:9–22:18 (emphasis added) (citing Ex. 1047 ¶ 44), 213:11–19, 214:6–215:6; *see also* Paper 33 (Citation 3). This testimony is persuasive. In particular, the difference in the length traveled by the light rays depending on whether Aizawa's wrist-worn sensor 2 uses a flat plate 6 or a convex plate 6 is extremely small. *See, e.g.*, Ex. 1006, Fig. 1(b), ¶ 26 (dotted line arrows show paths of light from emitter 21 to reflect off artery 11 in wrist 10 and return to detectors 22); *id.* at Fig. 2 (showing detector 1 mounted on a user's wrist, suggesting the general scale of detector 1); Ex. 1047 ¶¶ 8–22 (discussing typical light refractions by lenses in wrist-worn pulse sensors). Based on this scale, it is reasonable to

conclude, as Dr. Kenny does, that the central light *lost* by adding a protrusion will be outweighed by the peripheral light *gained* by adding a protrusion, despite the greater distance traveled by the peripheral light rays and the concomitant loss of intensity acknowledged by Dr. Kenny.

We also have reviewed Dr. Kenny's deposition testimony, cited by Patent Owner, concerning the complexity of using lenses in connection with an optically-driven pulse sensor, which Patent Owner asserts detracts from Dr. Kenny's opinion of obviousness. *See* Ex. 2006, 51:14–52:16, 75:20–77:2, 86:19–87:6, 91:9–92:13, 93:16–94:15, 96:15–21, 97:11–21, 100:17–101:18, 132:10–18, 154:4–7, 164:8–16, 189:11–190:13, 257:11–18; Ex. 2007, 308:12–309:8, 310:18–311:9, 318:3–6, 324:21–325:19, 331:19–332:11, 336:11–337:15, 333:20–335:4. This testimony reflects, at best, that Dr. Kenny's illustrations identifying the proposed modification of Aizawa's cover do not precisely reflect, at the scale required for manufacturing or testing purposes, the *exact* size and shape the convex protrusion would take when making and optimizing a real-world sensor. Such detail is not required to establish the obviousness of claim 1, which does not recite any such detail. Dr. Kenny's testimony, as discussed above, sufficiently establishes the obviousness of modifying Aizawa's flat cover to incorporate a convex protrusion to focus incoming diffuse light on Aizawa's peripheral detectors.

Patent Owner additionally asserts, and Dr. Madisetti testifies, that Dr. Kenny overlooks the "small" size of Aizawa's detectors 22 and the cavities 23c in which they are housed. *See* PO Resp. 20–21 (citing Ex. 1006, Figs. 1(a)–1(b), and Ex. 2006, 257:11–18); Ex. 2004 ¶ 63. We disagree. Even if Aizawa's detectors 22 are as small as Patent Owner

characterizes them, this provides more motivation for using a lens in Aizawa, to increase the amount of light that can be gathered by the small detectors.

Patent Owner similarly argues, and Dr. Madisetti testifies, that Dr. Kenny's illustration of how his proposed lens would reduce a mean path length of light traveling to Aizawa's detectors 22 as recited in dependent claim 12 (Pet. 38–39) "***drastically*** increases the size of the detectors compared to Aizawa and ***eliminates*** surrounding barriers" in Aizawa, which when properly taken into account "confirms the light ***would not even reach***" Aizawa's peripheral detectors 22 if a convex lens were applied. PO Resp. 21–22; Ex. 2004 ¶¶ 64–65. We disagree. These illustrations are not scaled representations of Petitioner's proposed modification to Aizawa, as Patent Owner would have it, but rather are abstract illustrations of how a convex protrusion functions to reduce the mean path length of refracted light versus a flat surface. *See* Pet. 38–39. We note also that the light receiving detection face 22s of each detector 22 in Aizawa is disposed near the open end of the corresponding cavity 23c, which is tapered to increase the light that can be collected by the detector. *See* Ex. 1006, Figs. 1(a)–1(b), ¶ 24.

We additionally do not agree with Patent Owner's argument that Petitioner's Reply presents new arguments and evidence that should have been first presented in the Petition, to afford Patent Owner an adequate opportunity to respond. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, in light of Inokawa, for the purpose of increasing the light gathering ability of Aizawa's device. *See* Pet. 13–16. The Patent Owner Response then challenged that contention, with several arguments that Petitioner's proposed convex protrusion would

not operate in the way the Petition alleges it would operate. *See* PO Resp. 11–34, *supra* Section III.D.3(c)(2)(ii). This opened the door for Petitioner to provide, in the Reply, arguments and evidence attempting to rebut the contentions in the Patent Owner Response. *See* PTAB Consolidated Trial Practice Guide (Nov. 2019) ("Consolidated Guide")[10], 73 ("A party also may submit rebuttal evidence in support of its reply."). This is what Petitioner did here. The Reply does not change Petitioner's theory for obviousness; rather, the Reply presents more argument and evidence in support of the same theory for obviousness presented in the Petition. *Compare* Pet. 13–16, *with* Reply 2–20.

Patent Owner finally argues that our conclusion of obviousness "strains credibility" because ordinary skill (*see supra* Section III.B) does not require specific education or experience with optics or optical physiological monitors. *See, e.g.*, PO Resp. 28–29. We disagree. Concerning motivation, a POSITA would have readily appreciated that: Aizawa's detector 1 operates by gathering light data with its photodetectors 22; an optical lens would be useful to focus the light on to the photodetectors; and optical lenses often are formed by providing a convex protrusion in the lens to focus light. Indeed, Inokawa discloses this exact utility, function, and structure. *See* Ex. 1008 ¶¶ 15, 58, Fig. 2.

Concerning reasonable expectation of success in using a convex protrusion lens to increase the amount of light directed to Aizawa's photodetectors, we have relied on Dr. Kenny's testimony that a POSITA would have understood a lens operates by increasing the light concentration

[10] Available at https://www.uspto.gov/TrialPracticeGuideConsolidated.

most where the curvature of the lens is the greatest, which leads to Dr. Kenny's proposed lens for use in Aizawa. *See, e.g.*, Ex. 1003 ¶¶ 95–97; Ex. 1047 ¶¶ 8–10, 15–22; Ex. 2006, 179:21–180:13, 202:11–20. We conclude a POSITA—that is, a person having a B.S. in an academic discipline emphasizing electrical, computer, or software technologies, and two years of related work experience with data collection—would have understood this general concept of optics. Moreover, the invention of claim 1 is recited at this same general level of utility and structure.

Thus, we conclude a POSITA would have been motivated to replace Aizawa's flat cover 6 with a cover comprising a convex protrusion in view of Inokawa, to improve light detection efficiency, and would have had a reasonable expectation of success in doing so.

d) Conclusion as to Claim 1

Based on the foregoing arguments and evidence, we conclude Petitioner has demonstrated by a preponderance of the evidence that claim 1 is unpatentable as having been obvious over Aizawa and Inokawa.

4. Claims 2–4, 6–14, 16, 17, 19–23, and 26–29

Petitioner provides arguments and evidence, including testimony from Dr. Kenny, in support of contending claims 2–4, 6–14, 16, 17, 19–23, and 26–29 are unpatentable as having been obvious over Aizawa and Inokawa. Pet. 29–48; Ex. 1003 ¶¶ 100–138. In defense of these claims, Patent Owner relies solely on arguments relating to claim 1. *See, e.g.*, PO Resp. 11–40. For the reasons provided in Section III.D.3 above in relation to claim 1, we conclude Patent Owner's defense is unavailing.

Concerning independent claim 26, our analysis of claim 1 above applies equally well to the bulk of claim 26. Claim 26 differs from claim 1 most significantly in specifying that the device's housing is "circular" and comprises "a surface with a raised edge," and the device's cover comprises "a lens portion." *Compare* Ex. 1001, 44:66–45:15 (claim 1), *with id.* at 46:47–65 (claim 26). We find Aizawa's housing is circular and comprises a surface with a raised edge. *See* Pet. 45–46 (annotating Aizawa's Figures to identify the "Circular housing" in red, the "Surface" in brown, and the "Raised edge" in purple). We also find the cover of Aizawa, as modified by Inokawa to have a convex protrusion, comprises a lens portion. *See supra* Section III.D.3.

Concerning dependent claims 2–4, 6–14, 16, 17, 19–23, and 27–29, we find a preponderance of the evidence supports Petitioner's contentions that Aizawa's pulse rate detector 1 exhibits the limitations recited in these claims, or that a POSITA would have been motivated to implement them in Aizawa, based on the evidence cited and the reasons provided in the Petition, which we adopt as our own here. *See* Pet. 29–45, 46–48.

Thus, we conclude Petitioner has demonstrated by a preponderance of the evidence that claims 2–4, 6–14, 16, 17, 19–23, and 26–29 are unpatentable as having been obvious over Aizawa and Inokawa.

E. Ground 1B — Obviousness over Aizawa, Inokawa, and Ohsaki

In Ground 1B, Petitioner argues claims 1–4, 6–14, 16, 17, 19–23, and 26–29 of the '265 patent would have been obvious over Aizawa, Inokawa, and Ohsaki. Pet. 2, 48–51. Patent Owner opposes. PO Resp. 40–44. We conclude a preponderance of the evidence supports Petitioner's

assertions as to all challenged claims. We begin our analysis with a brief summary of Ohsaki, then we address the parties' contentions.

1. Ohsaki Disclosure

Ohsaki discloses a pulse wave sensor attached to the back side of the user's wrist. Ex. 1014, codes (54) & (57). Figures 1 and 2 are reproduced below:

FIG. 1

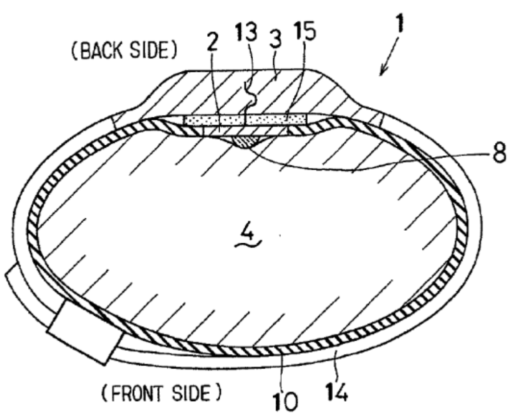


FIG. 2

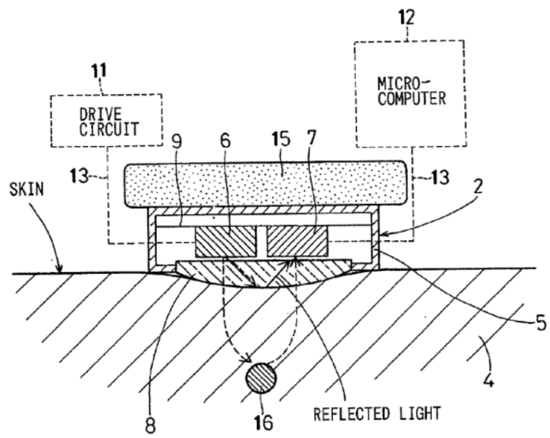


Figure 1 is a cross-sectional view of pulse wave sensor 1 attached on a user's wrist 4. *Id.* ¶¶ 12, 16, 18. Figure 2 is a schematic diagram of detecting element 2 of sensor 1 on wrist 4, and associated electronics. *Id.* ¶¶ 13, 17.

Figure 1 illustrates how detecting element 2 is attached to the back side of the wrist. In this context, the wrist's "back" side is the side opposite to the user's palm, and the wrist's "front" side is the palm side of the hand. *See, e.g.*, *id.* ¶¶ 5–6, 16.

Detecting element 2 comprises a light emitter (LED 6) and a light detector (photodetector 7) for optically interrogating the user's wrist 4 tissue to detect a pulse wave of the user. *See id.* ¶¶ 3, 7–8, 16, 20, 22. Translucent board 8 of element 2 has "a convex surface . . . in intimate contact with the

surface of the user's skin," and "[t]hereby it is prevented that the detecting element 2 slips off the detecting position of the user's wrist 4." *Id.* ¶¶ 9, 17–18, 25.

Figures 3A–3B provide test data comparing the performance of a pulse wave sensor depending on whether it is mounted to the back side or the front side of the user's wrist. *See id.* at Figs. 3A–3B, ¶¶ 14, 23–24. Figures 4A–4B provide test data comparing the performance of a pulse wave sensor depending on whether translucent board 8 is convex (as shown in Figures 1 and 2) or flat. *See id.* at Figs. 4A–4B, ¶¶ 15, 25.

2. Claim 1

Petitioner provides arguments and evidence, including testimony from Dr. Kenny, in support of Petitioner's contention that claim 1 is unpatentable as having been obvious over Aizawa, Inokawa, and Ohsaki. Pet. 48–51; Ex. 1003 ¶¶ 64–65, 139–143. Patent Owner provides arguments and evidence in opposition, including testimony from Dr. Madisetti. PO Resp. 40–44; Ex. 2004 ¶¶ 90–96.

Ground 1B incorporates Ground 1A, then adds Ohsaki as providing a further motivation for modifying Aizawa's flat plate 6 to have a convex protrusion. *See* Pet. 50–51; Ex. 1003 ¶¶ 139–143. Petitioner asserts "Ohsaki teaches that adding a convex surface to the light permeable cover (*i.e.*, [Ohaski's] translucent board 8) can help prevent the device from slipping on the tissue when compared to a flat cover" such as Aizawa's plate 6. Pet. 50–51 (citing Ex. 1014 ¶ 25); Ex. 1003 ¶ 141. Petitioner asserts that Aizawa, similarly to Ohsaki, "seeks to prevent slippage between the device and the user's wrist—and pursues this objective by pressing its

[plate 6] and trying to improve 'adhesion between the wrist 10 and the pulse rate detector 11.'" Pet. 51 (citing Ex. 1006 ¶¶ 26, 30); Ex. 1003 ¶ 142. Dr. Kenny testifies a POSITA "would have recognized that Ohsaki's addition of a convex protrusion to its light permeable cover could be similarly implemented in Aizawa's device to help achieve the two references' shared goal of minimizing slippage," which "would have allowed Aizawa's sensor device to remain better adhered to the skin and thereby increase its light-collecting efficiency." Ex. 1003 ¶ 142 (citing Ex. 1006 ¶¶ 26, 30; Ex. 1014 ¶ 25); Pet. 51.

Patent Owner argues in opposition that the Petition is fatally deficient because it is "unclear as to whether a POSITA would have incorporated Inokawa's lens or Ohsaki's translucent board" in Aizawa. PO Resp. 40–41; Ex. 2004 ¶ 90. We disagree. Ground 1A relies on Inokawa as providing a first motivation for adding a protrusion to Aizawa's flat cover: to direct more light to Aizawa's detectors 22. *See supra* Section III.D.3(c)(2). Ground 1B relies additionally on Ohsaki as providing a second, and independent, motivation for adding a protrusion to Aizawa's flat cover: to reduce slippage between Aizawa's device and the user's wrist. *See* Pet. 50–51. Neither ground seeks to bodily incorporate Inokawa's lens or Ohsaki's translucent board into Aizawa's device, and this is not required for obviousness. *See Keller*, 642 F.2d at 425.

Patent Owner next contends that Patent Owner's various arguments opposing Ground 1A also apply to Ground 1B. *See* PO Resp. 41; Ex. 2004 ¶ 92. For the reasons provided in Section III.D.3 above, Patent Owner's arguments opposing Ground 1A are unavailing.

Patent Owner further asserts a POSITA would have understood "Ohsaki would not prevent slippage with Aizawa's device." PO Resp. 42 (section heading modified). According to Patent Owner, Ohsaki indicates "its convex surface must have ***longitudinal directionality***" such that "one must orient its longitudinal convex surface with the longitudinal direction of the user's arm." PO Resp. 42 (citing Ex. 1014 ¶ 19); Ex. 2004 ¶ 93. Patent Owner argues Aizawa's detector 1, by contrast, uses a circular arrangement of four detectors 22 around one emitter 21, and "Aizawa specifically ***distinguishes*** its sensor from linear sensors such as Ohsaki's." PO Resp. 42–43 (citing Ex. 1006, code (57), ¶¶ 9, 27, 36; Ex. 1014 ¶ 19; Ex. 2008, 165:20–166:5); Ex. 2004 ¶ 94. Patent Owner concludes a "POSITA would not have believed Ohsaki's longitudinal convex surface would benefit Aizawa's device" due to this difference. PO Resp. 43; Ex. 2004 ¶ 95.

Patent Owner moreover argues Ohsaki's "convex surface only prevents slipping on the backhand side (i.e., watch side) of the user's wrist," and Ohsaki's "sensor has 'a tendency to slip off' if it is on the palm side of the user's wrist." PO Resp. 42–43 (citing Ex. 1014 ¶¶ 23–24, Figs. 3A–3B); Ex. 2004 ¶¶ 93, 95. Patent Owner asserts Aizawa's detector 1, by contrast, is held against the front side of the user's wrist to be close to the artery there, and "Aizawa reports that on the ***palm side*** of the wrist, a ***flat surface*** improves adhesion." PO Resp. 42–43 (citing Ex. 1006, Figs. 2 and 3, code (57), ¶¶ 2, 9, 13, 26–28, 30, 34, 36); Sur-reply 20 (further citing Ex. 1006 ¶ 33); Ex. 2004 ¶¶ 94–95. Patent Owner cites evidence demonstrating that these arteries are on the front side of the wrist. PO Resp. 43 (citing Ex. 2010, Plates 427 and 429); Ex. 2004 ¶ 95. Patent Owner concludes a POSITA would not have believed Ohsaki's convex

surface would benefit Aizawa's device based on this difference in device location on the user's wrist. PO Resp. 43; Ex. 2004 ¶ 95.

Petitioner replies that, despite the differences between Aizawa and Ohsaki identified by Patent Owner, a POSITA would nonetheless have understood from Ohsaki that "a convex surface . . . can help prevent the device from slipping on the tissue of the wearer compared to using a flat cover without such protrusion." Pet. Reply 23–25 (quoting Ex. 1003 ¶ 141); Ex. 1047 ¶¶ 50–52. According to Petitioner, Ohsaki contrasts between "flat" and "convex" detecting surfaces, and explains the "detected pulse wave is adversely affected by the movement of the user's wrist" with a flat surface but not a convex surface. Pet. Reply 24 (citing Ex. 1014, Figs. 1, 2, & 4A–4B, ¶¶ 15, 17, 25; Ex. 1003 ¶ 142); Ex. 1047 ¶ 52. Petitioner asserts "Ohsaki was relied upon not for its exact cover configuration" as Patent Owner suggests, but instead "for the rather obvious concept that a convex surface protruding into a user's skin will prevent slippage." Pet. Reply 25; Ex. 1047 ¶ 52 ("[A]dding a convex surface to Aizawa's flat plate will serve to ***improve*** its tendency to not slip off, not take away from it, since it is well understood that physically extending into the tissue and displacing the tissue with a protrusion provides an additional adhesive effect.").

Patent Owner replies "Ohsaki demonstrates that a convex surface alone does ***not*** prevent slipping because Ohsaki's shape is designed to fit within the underlying bone structure of the wrist and forearm on the backhand side." Sur-reply 20 (citing Ex. 1014, Figs. 3A–3B, ¶¶ 6, 19, 23–24). Patent Owner asserts "Ohsaki explains that a convex surface on the palm side has a tendency to slip, notwithstanding any alleged 'physical[] digging.'" *Id.* Ohsaki also teaches, according to Patent Owner, "that one

should avoid too much pressure because otherwise the user 'feels uncomfortable,' which results in movement and a tendency to slip." *Id.* (citing Ex. 1014 ¶¶ 6, 18, 24).

Upon review of the foregoing arguments and evidence, we conclude a preponderance of the evidence supports Petitioner's contention that a POSITA would have been motivated to modify Aizawa's plate 6 to include a convex protrusion, in order to help prevent slippage of Aizawa's detector 1 on the user's wrist, based on Ohsaki.

We find a POSITA would have understood from Ohsaki that forming a convex protrusion on the face of an optically-based pulse sensor where it is pressed against the user's wrist to gather optical data will beneficially prevent slippage of the sensor during operation. Ohsaki states: "The detecting element 2 is arranged on the user's wrist 4 so that *the convex surface* of the translucent board 8 *is in intimate contact with the surface of the user's skin*. *Thereby it is prevented that the detecting element 2 slips* off the detecting position of the user's wrist 4." Ex. 1014 ¶ 25 (emphases added). A POSITA would understand from this disclosure that forming a convex protrusion on the tissue-contacting face of a wrist-worn, optically-based pulse sensor will resist movement of the sensor on the user's wrist during use. *See* Ex. 1003 ¶¶ 141–142; Ex. 1047 ¶ 52. A POSITA would also understand this resistance to be a beneficial result, because it will improve the pulse sensor's ability to emit light into and detect light reflected from the user's wrist, to generate a pulse signal. *See* Ex. 1006 ¶¶ 26, 30, 34; Ex. 1014 ¶¶ 23, 25, 27; Ex. 1003 ¶¶ 141–142; Ex. 1047 ¶ 52.

Indeed, Ohsaki expressly compares the performance of a wrist-worn pulse wave sensor depending on whether translucent board 8 is convex or

flat, and concludes the former results in improved performance over the latter, especially when the user is moving. *See id.* at Figs. 4A–4B, ¶¶ 15, 25 (stating that with "a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4," and with "a convex surface like the present embodiment, the variation of the amount of the reflected light" collected by the sensor "is suppressed"). Ohsaki also states that, with a convex protrusion, it is "prevented that noise such as disturbance light from the outside penetrates the translucent board 8." *Id.* ¶ 25.

Patent Owner and Dr. Madisetti attempt to limit the foregoing disclosures of Ohsaki to its particular context—a sensor having one emitter 6 disposed next to one detector 7 to define a "longitudinal" sensing direction between them, and being attached to the back side rather than the front side of the user's wrist. *See* Ex. 2004 ¶¶ 93–95. We are not persuaded. For example, Ohsaki's disclosure does not support Dr. Madisetti's conclusion that it is *only* in this particular context that a convex protrusion will help prevent slippage. *See* Ex. 1014 ¶ 19 (discussing the longitudinal direction orientation of Ohsaki's sensor); *id.* at Figs. 3A–3B, ¶¶ 16, 23–24 (discussing attaching Ohsaki's sensor to the back side of the wrist). Figures 3A–3B compare the performance of detecting element 2, including its translucent board 8 having a convex protrusion, and show better performance when it is attached to the back side of the wrist versus the front side of the wrist, when the user is in motion. *See* Ex. 1014 ¶ 17 (Fig. 2), ¶¶ 23–24 (Figs. 3A–3B). Because the tested device incorporates a convex protrusion in both instances, Figures 3A–3B do not support Dr. Madisetti's conclusion that "Ohsaki teaches that a convex surface on the palm side of the wrist would not prevent

slipping" — particularly in comparison to a flat surface such as Aizawa's. Ex. 2004 ¶ 95.

We credit, instead, Dr. Kenny's testimony that a POSITA would have understood from Ohsaki that a convex protrusion will help prevent slippage, even in the context of Aizawa's arrangement of four detectors surrounding a central emitter (or emitters, when modified per Inokawa) attached on the front side of the user's wrist. *See* Ex. 1047 ¶ 52. This is because, even in Aizawa's arrangement, the convex protrusion will "physically extend[] into the tissue and displac[e] the tissue," as is illustrated for example in Ohsaki's Figures 1 and 2, where translucent board 8 physically extends into and displaces the tissue of wrist 4. *Id.*

Dr. Madisetti also testifies that "Aizawa reports that on the palm side of the wrist, a flat surface improves adhesion," so "a POSITA would have believed that adding Ohsaki's convex surface would have disrupted the improved adhesion properties reported for Aizawa's flat plate." Ex. 2004 ¶ 95 (citing Ex. 1006, Figs. 3A–3B, ¶¶ 13, 26, 28, 30, 34; Ex. 1014, Figs. 3A–3B, ¶¶ 23–24). We disagree with this reading of Aizawa. It is true that Aizawa's plate 6 is illustrated as having a flat surface (Ex. 1006, Fig. 1(b)), and that Aizawa states the plate "improve[s] adhesion" (*id.* ¶ 13). Aizawa also states: "the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10," and "[t]hereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶ 26. These disclosures, however, indicate the improved adhesion is provided by the acrylic material of plate 6, not the flat surface of plate 6 as Dr. Madisetti would have it. *See also id.* ¶¶ 30, 34 ("Since the acrylic transparent plate 6 is provided . . . adhesion between the pulse rate

detector 1 and the wrist 10 can be improved . . . ."). Thus, there is no teaching away from using a convex surface to improve the adhesion of Aizawa's detector to the user's wrist. *See, e.g.*, Ex. 1003 ¶ 142; Ex. 1047 ¶ 52.

Finally, we acknowledge that both Aizawa and Ohsaki express a concern about exerting too much pressure against the front side of the user's wrist, because this would make the user uncomfortable. *See, e.g.*, Ex. 1006 ¶¶ 6, 26, 31; Ex. 1014 ¶¶ 6, 18, 24. Thus, a POSITA would understand that there are operational limits on how large the protrusion can be made in Aizawa. Nonetheless, claim 1 does not place any limitations on the size of the protrusion, and as discussed above a protrusion would improve the ability to avoid slippage of Aizawa's detector 1 when worn on the front side of a user's wrist. Therefore, it would have been obvious to add a protrusion to Aizawa's detector 1 for that purpose, and optimize the size of the protrusion to avoid user discomfort.

Based on the foregoing arguments and evidence, we conclude Petitioner has demonstrated by a preponderance of the evidence that claim 1 is unpatentable as having been obvious over Aizawa, Inokawa, and Ohsaki.

3. Claims 2–4, 6–14, 16, 17, 19–23, and 26–29

Petitioner relies on its arguments from Ground 1A in contending that claims 2–4, 6–14, 16, 17, 19–23, and 26–29 are unpatentable under Ground 1B, which adds Ohsaki to Ground 1A. *See* Pet. 51; Ex. 1003 ¶ 143. In defense of these claims, Patent Owner relies solely on arguments relating to claim 1. *See, e.g.*, PO Resp. 40–44; Ex. 2004 ¶ 96. Thus, for the reasons provided above in relation to Ground 1A (all challenged claims) and

Ground 1B (claim 1), we conclude Petitioner has demonstrated by a preponderance of the evidence that claims 2–4, 6–14, 16, 17, 19–23, and 26–29 are unpatentable as having been obvious over Aizawa, Inokawa, and Ohsaki.

F. Ground 1C — Obviousness over Aizawa, Inokawa, and Mendelson-2006

In Ground 1C, Petitioner argues claims 23 and 24 of the ’265 patent would have been obvious over Aizawa, Inokawa, and Mendelson-2006. Pet. 2, 51–57.

Claim 23 depends from claim 1 to add “the noninvasive optical physiological measurement device is comprised as *part of a mobile monitoring device*,” and claim 24 depends from claim 23 to add “the mobile monitoring device includes *a touch-screen display*.” Ex. 1001, 46:34–40 (emphases added).

Petitioner provides arguments and evidence, including testimony from Dr. Kenny, in support of its obviousness contentions. Pet. 51–57; Ex. 1003 ¶¶ 69–71, 144–150. Petitioner relies on Aizawa and Inokawa as in Ground 1A for the parent claim 1, and cites Mendelson-2006 for the obviousness of uploading pulse data recorded by Aizawa’s wrist-worn detector 1 to a mobile computing device having a touchscreen display for display to the user, thereby resulting in the device of claims 23 and 24. Pet. 51–57; Ex. 1003 ¶¶ 69–71, 144–150. In a footnote, Petitioner adds: “Alternatively, the combination of Aizawa, Inokawa, and Ohsaki, as described in [Ground 1B], may be similarly modified in view of Mendelson-2006.” Pet. 54 n.2.

Patent Owner's opposition relies on arguments relating to claim 1 and Grounds 1A and 1B. *See* PO Resp. 44; Ex. 2004 ¶ 97. Patent Owner additionally objects to Petitioner's footnote reference to Ohsaki, as presenting a "conclusory alternative combination[] that add[s] another reference without any analysis, and with no motivation to combine." PO Resp. 44. Patent Owner further asserts "arguments raised only in footnotes are waived." *Id.* (citing *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1383 (Fed. Cir. 2015)).

For reasons provided in Section III.D.3 above, we conclude Petitioner has demonstrated by a preponderance of the evidence that claim 1 is unpatentable over Aizawa and Inokawa pursuant to Ground 1A, over Patent Owner's objections. We further find Petitioner's reliance on Mendelson-2006 as disclosing the additional subject matter recited in claims 23 and 24 is supported by a preponderance of the evidence. Figure 1 of Mendelson-2006 is reproduced below:

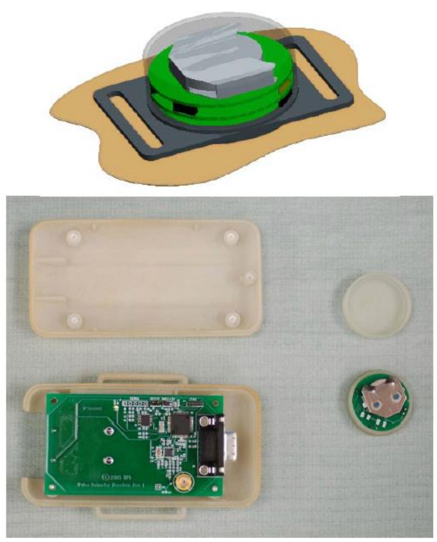


Fig. 1. (Top) Attachment of Sensor Module to the skin; (Bottom) photograph of the Receiver Module (left) and Sensor Module (right).

Figure 1 is a picture of "a body-worn pulse oximeter that receives and processes PPG [photoplethysmographic] signals," comprising a Sensor

Module and a Receiver Module. Ex. 1016, 912–913. The Sensor Module consists of an optical transducer, a stack of round printed circuit boards, and a coin-cell battery, and is attached to the user's skin to gather the PPG data. *Id.* at 912 (abstract), 913. The Sensor Module transmits its data wirelessly to the Receiver Module, which is also "body-worn." *Id.* at 913. "The data processed by the Receiver Module can be transmitted wirelessly to a PDA," which is not shown in Figure 1. *Id.*

Figure 3 of Mendelson-2006 is reproduced below:

Fig. 3. Sample PDA Graphical User Interface (GUI).

Figure 3 is a picture of a PDA that may be used with the body-worn Sensor Module and Receiver Module, and this PDA "provides a low-cost touch screen interface." *Id.* at 913–914.

Thus, Mendelson-2006 discloses a noninvasive optical physiological measurement device comprised as part of a mobile monitoring device (claim 23) wherein the mobile monitoring device includes a touch-screen display (claim 24). We additionally conclude a person of ordinary skill in the art would have been motivated to configure Aizawa's body-worn detector 1 to transmit its data to a touch screen PDA such as is disclosed in Mendelson-2006, based on the evidence cited and the reasons provided in the Petition, which we adopt as our own here. *See* Pet. 51–57; Ex. 1003

¶¶ 144–150. Thus, we conclude Petitioner has demonstrated by a preponderance of the evidence that claims 23 and 24 are unpatentable as having been obvious over Aizawa, Inokawa, and Mendelson-2006.

In addition, for reasons provided in Section III.E.2 above, we conclude Petitioner has demonstrated by a preponderance of the evidence that claim 1 is unpatentable over Aizawa, Inokawa, and Ohsaki, pursuant to Ground 1B, over Patent Owner's objections. Petitioner's reliance on Ohsaki as providing motivation for adding a protrusion to Aizawa's flat cover to reduce slippage (Ground 1B) is unrelated to, and is not inconsistent with, Petitioner's reliance on Mendelson-2006 for the obviousness of sending data to a mobile monitoring device with a touch screen display (Ground 1C). Thus, we conclude Petitioner has demonstrated by a preponderance of the evidence that claims 23 and 24 are unpatentable as having been obvious over Aizawa, Inokawa, Ohsaki, and Mendelson-2006.

Concerning Petitioner's reliance on Ohsaki in this Ground 1C, Patent Owner cites a Federal Circuit decision that states "[a]rguments raised only in footnotes . . . are waived." *Kennametal*, 780 F.3d at 1383 (quoting *Otsuka Pharm. Co., Ltd. v. Sandoz, Inc.*, 678 F.3d 1280, 1294 (Fed. Cir. 2012) (citing *SmithKline Beecham Corp. v. Apotex Corp.*, 439 F.3d 1312, 1320 (Fed. Cir. 2006))). However, this appears to be a rule applied by the Federal Circuit to briefs filed with that Court, as opposed to a precedential rule of law the Board is compelled to follow. *See Otsuka*, 678 F.3d at 1294. In addition, to the extent it is binding precedent on the Board, we are permitted to "exercise our discretion to consider" arguments "improperly raised" only in a footnote. *Id.* (citing *Becton Dickinson & Co. v. C.R. Bard, Inc.*,

922 F.2d 792, 800 (Fed. Cir. 1990)). We do so here, to provide a complete record for review by the Federal Circuit in the event of an appeal.

G. Ground 1D — Obviousness over Aizawa, Inokawa, Goldsmith, and Lo

In Ground 1D, Petitioner argues claims 23 and 24 of the ’265 patent would have been obvious over Aizawa, Inokawa, Goldsmith, and Lo. Pet. 2, 57–62. We have already determined claim 23 is unpatentable based on Grounds 1A, 1B, and 1C, and claim 24 is unpatentable based on Ground 1C. Therefore, we need not, and to conserve the Board’s resources we do not, reach Ground 1D. *See Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App’x 984, 990 (Fed. Cir. 2020) (“[T]he Board need not address issues that are not necessary to the resolution of the proceeding.”).

H. Ground 1E — Obviousness over Aizawa, Inokawa, Mendelson-2006, and Beyer

In Ground 1E, Petitioner argues claim 25 of the ’265 patent would have been obvious over Aizawa, Inokawa, Mendelson-2006, and Beyer. Pet. 2, 62–65.

Claim 25 recites:

> 25. A physiological monitoring system comprising:
>
> the noninvasive optical physiological measurement device of claim 1; and
>
> a processor configured to receive the one or more signals and communicate physiological measurement information to a mobile phone.

Ex. 1001, 46:41–46.

Petitioner provides arguments and evidence, including testimony from Dr. Kenny, in support of its obviousness contentions. Pet. 62–65; Ex. 1003

¶¶ 158–164. Petitioner relies on Aizawa, Inokawa, and Mendelson-2006 as in Ground 1C for the obviousness of "a monitoring system that includes, among other things, a wrist-worn sensor (as in Aizawa) and a mobile PC (as in Mendelson-2006)" to receive signals from the wrist-worn sensor. Pet. 62–63; Ex. 1003 ¶¶ 158–160. Petitioner then addresses the "mobile phone" limitation of claim 25, and contends it would have been obvious to implement this additional subject matter in the combination of Aizawa, Inokawa, and Mendelson-2006, based on Beyer. Pet. 62–65; Ex. 1003 ¶¶ 72, 160–164. In a footnote, Petitioner adds: "Alternatively, the combination of Aizawa, Inokawa, and Ohsaki, as described in [Ground 1B], may be similarly modified in view of Mendelson-2006 and Beyer." Pet. 62 n.4.

Patent Owner's opposition relies on arguments relating to claim 1 and Grounds 1A and 1B. *See* PO Resp. 44; Ex. 2004 ¶ 97. Patent Owner additionally objects to Petitioner's footnote reference to Ohsaki, as presenting a "conclusory alternative combination[] that add[s] another reference without any analysis, and with no motivation to combine." PO Resp. 44. Patent Owner further asserts "arguments raised only in footnotes are waived." *Id.* (citing *Kennametal*, 780 F.3d at 1383).

For reasons provided in Section III.D.3 above, we conclude Petitioner has demonstrated by a preponderance of the evidence that claim 1 is unpatentable over Aizawa and Inokawa pursuant to Ground 1A, over Patent Owner's objections. For reasons provided in Section III.F above, we also conclude the combination of Aizawa, Inokawa, and Mendelson-2006 leads to the invention of claim 25, except for the "mobile phone" limitation.

We further find Petitioner's reliance on Beyer as disclosing the "mobile phone" limitation of claim 25 is supported by a preponderance of the evidence. Beyer discloses "a small handheld cellular phone / PDA communications system" that is similar to the PDA of Mendelson-2006. Ex. 1019, Fig. 1, 7:17–20. We also agree with Petitioner's contention that a person of ordinary skill in the art would have been motivated to modify the PDA of Mendelson-2006, which "does not explicitly disclose the PDA to be a mobile phone," to incorporate cellular communication technology in order to provide the additional communication capabilities of a mobile phone, as disclosed by Beyer. Pet. 63–65 (citing Ex. 1016, 914; Ex. 1019, 1:6–15); Ex. 1003 ¶¶ 161–164. A person of ordinary skill in the art also would have been motivated to do this to enable review of the user's data at a location that is remote to the user. Pet. 64–65 (citing Ex. 1021, code (57), Fig. 3); Ex. 1003 ¶ 162. Thus, we conclude Petitioner has demonstrated by a preponderance of the evidence that claim 25 is unpatentable as having been obvious over Aizawa, Inokawa, Mendelson-2006, and Beyer.

In addition, for reasons provided in Section III.E.2 above, we conclude Petitioner has demonstrated by a preponderance of the evidence that claim 1 is unpatentable over Aizawa, Inokawa, and Ohsaki, pursuant to Ground 1B, over Patent Owner's objections. Petitioner's reliance on Ohsaki as providing motivation for adding a protrusion to Aizawa's flat cover to reduce slippage (Ground 1B) is unrelated to, and is not inconsistent with, Petitioner's reliance on Mendelson-2006 and Beyer for the obviousness of sending data to a mobile device with a touch screen display and mobile phone communication capability (Grounds 1C and 1E). Thus, we conclude Petitioner has demonstrated by a preponderance of the evidence that

claim 25 is unpatentable as having been obvious over Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Beyer. As discussed above, the fact that this theory of obviousness is articulated in a footnote in the Petition does not persuade us to overlook its merits.

I. Ground 2A — Obviousness over Mendelson-1988 and Inokawa

In Ground 2A, Petitioner argues claims 1–4, 6–14, 16–22, and 26–30 of the ’265 patent would have been obvious over Mendelson-1988 and Inokawa. Pet. 2, 66–95. Patent Owner opposes. PO Resp. 44–60. We conclude a preponderance of the evidence supports Petitioner’s assertions as to claims 1, 2, 4, 14, 17–22, and 26–30, but not claims 3, 6–13, and 16. We begin our analysis with a brief summary of Mendelson-1988, then we address the parties’ contentions.

1. Mendelson-1988 Disclosure

Mendelson-1988 discloses a pulse oximeter, with an optical reflectance sensor suitable for noninvasive monitoring of a user’s arterial hemoglobin oxygen saturation (SpO_2), via the user’s forehead. *See* Ex. 1015, 167 (title & abstract). Figure 2 is reproduced below:

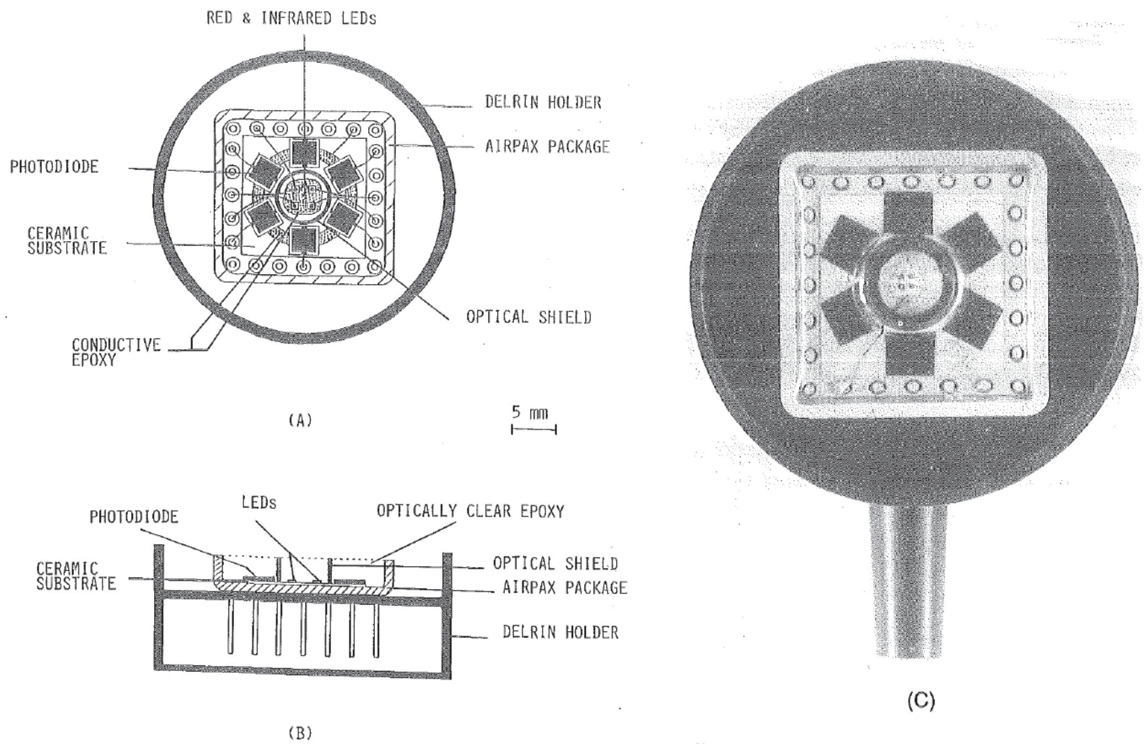


Figure 2 illustrates the sensor of Mendelson-1988, including: (A) a top view diagram; (B) a side view diagram; and (C) a photograph. *Id.* at 169.

The sensor includes two red LEDs and two infrared LEDs for emitting light into the user's tissue, and six photodiodes "arranged symmetrically in a hexagonal configuration" surrounding the four emitters, to detect light reflected back to the sensor from the user's tissue. *Id.* at 168 ("SENSOR DESIGN"). The user's "SpO_2 can be calculated from the ratio of the reflected red and infrared photoplethysmograms." *Id.* at 167 (col. 2). "To minimize the amount of light transmission and reflection between the LEDs and the photodiodes within the sensor, a ring-shaped, optically opaque shield of black Delrin . . . was placed between the LEDs and the photodiode chips." *Id.* at 168 (col. 2). "The optical components were encapsulated inside the package using optically clear adhesive." *Id.* "The microelectronic package was mounted inside a black Delrin housing." *Id.*

2. Claim 1

Petitioner provides arguments and evidence, including testimony from Dr. Kenny, in support of contending claim 1 is unpatentable as having been obvious over Mendelson-1988 and Inokawa. Pet. 66–78; Ex. 1003 ¶¶ 66–68, 165–181. Patent Owner provides arguments and evidence in opposition, including testimony from Dr. Madisetti. PO Resp. 44–53, 58–60; Ex. 2004 ¶¶ 34, 98–117, 126–129.

a) Comparing Claim 1 with Mendelson-1988

Petitioner contends Mendelson-1988's SpO_2 sensor exhibits each and every limitation of claim 1, except that its light permeable cover (i.e., the "OPTICALLY CLEAR EPOXY" in Figure 2B) lacks the claimed "protrusion." *See* Pet. 66–78; Ex. 1003 ¶¶ 66–68, 165–181. We determine this contention is supported by a preponderance of the evidence, over Patent Owner's objections, as follows.

We find Mendelson-1988's sensor exhibits several limitations of claim 1, which are not challenged by Patent Owner. Thus, we find the sensor is a noninvasive optical measurement device adapted to be worn on a user's forehead, to provide an indication of a physiological parameter of the user (i.e., SpO_2).[11] *See* Ex. 1015, 167 (abstract); Pet. 71; Ex. 1003 ¶ 165. We find the sensor has two infrared LED chips and two red LED chips. *See* Ex. 1015, 168 (col. 2) ("The optical reflectance sensor used in this study consists of two red (peak emission wavelength: 660 nm) and two infrared (peak emission wavelength: 930 nm) LED chips[.]"), 169 (Fig. 2);

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[11] Whether the preamble is limiting need not be resolved, because the recitation in the preamble is satisfied by the prior art.

Pet. 71–72; Ex. 1003 ¶ 166. We find the sensor includes a housing having a surface and a circular wall protruding from the surface. *See* Ex. 1015, 169 (Fig. 2); Ex. 1003 ¶ 167. In particular, Petitioner annotates Mendelson-1988's Figures 2A and 2B to identify the "Housing" in red, the "Surface" in purple, and the "Circular wall" in green. *See* Pet. 72–73; Ex. 1003 ¶ 167. We find the sensor further includes at least four detectors (i.e., the six photodiodes) arranged on the housing's surface and spaced apart from each other, symmetrically on a circle centered on the four LEDs. *See* Ex. 1015, 168 (col. 2) (stating the six photodiodes are "arranged symmetrically in a hexagonal configuration"), 169 (Fig. 2); Pet. 75–76; Ex. 1003 ¶ 171. We find the six detectors are configured to output signals responsive to light emitted from the four emitters and attenuated by the user's body tissue, with the signals being indicative of the user's SpO_2. *See* Ex. 1015, 167 (col. 2) ("SpO_2 can be calculated from the ratio of the reflected red and infrared photoplethysmograms"); Pet. 75–76; Ex. 1003 ¶ 171.

Petitioner contends Mendelson-1988's sensor has a light permeable cover (i.e., the "OPTICALLY CLEAR EPOXY" in Figure 2B) arranged above a portion of the housing (i.e., the "AIRPAX PACKAGE" in Figure 2B) to cover the six detectors. *See* Pet. 67; Ex. 1003 ¶ 172. Patent Owner disagrees, relying on its claim construction of the term "cover" which would exclude resins and epoxies. *See* PO Resp. 50–51. For reasons provided in Section III.C.1 above, Patent Owner's claim construction is not persuasive, so Mendelson-1988 cannot be distinguished from claim 1 on this basis.

We find a preponderance of the evidence establishes that the Mendelson-1988 sensor's optically clear epoxy is a light permeable cover that covers the sensor's six detectors. In particular, it is clear from Figures 2A and 2B that the epoxy extends from the top of the sensor at the dotted line in Figure 2B, down into the well of the AIRPAX package, to cover all four LEDs and all six photodiodes disposed at the bottom of the well. *See also* Ex. 1015, 168 (col. 2) ("The optical components were encapsulated inside the package using optically clear adhesive[.]").

Thus, we find Mendelson-1988's sensor exhibits each and every limitation of claim 1, except that its light permeable cover is flat, and therefore lacks the claimed "protrusion."

b) Comparing Claim 1 with Inokawa

Petitioner contends Inokawa's pulse sensor 1 is a noninvasive optical measurement device having a light permeable cover (i.e., lens 27) comprising a protrusion arranged to cover its light detector(s) (i.e., detector 25), as discussed in Section III.D.3(b) above. *See* Pet. 68; Ex. 1003 ¶ 174. Patent Owner does not challenge Petitioner's contentions in this regard. We determine these contentions are supported by a preponderance of the evidence, as discussed in Section III.D.3(b) above.

c) Obviousness of Combining Mendelson-1988 and Inokawa

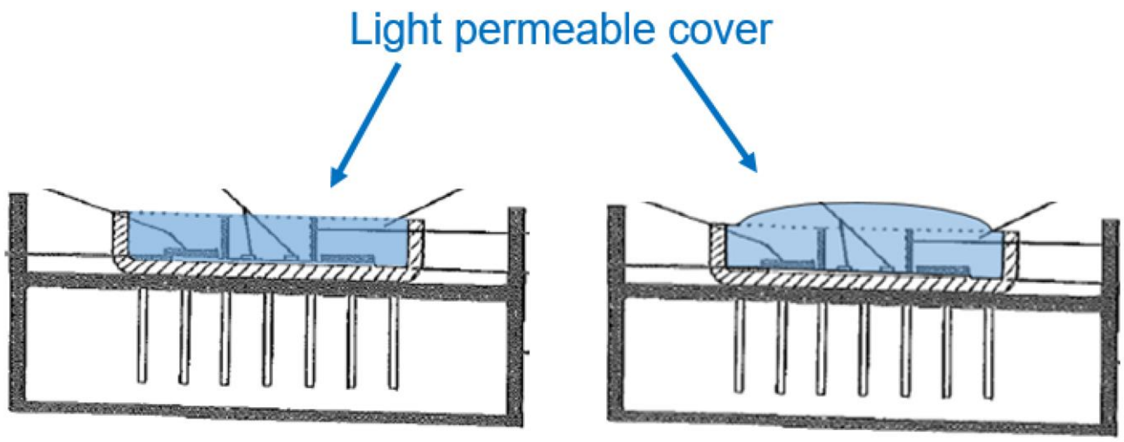
Petitioner contends a POSITA would have been motivated to modify Mendelson-1988's optical SpO_2 sensor, in light of Inokawa's optical pulse sensor, by adding a protrusion to Mendelson-1988's cover to improve the sensor's light detection efficiency. *See* Pet. 67–71, 76–78. Patent Owner opposes this contention, and argues a person of ordinary skill in the art

would not have had a reasonable expectation of success, among other things. *See* PO Resp. 44–49, 51–53, 58–60.

(1) Petitioner's Contentions

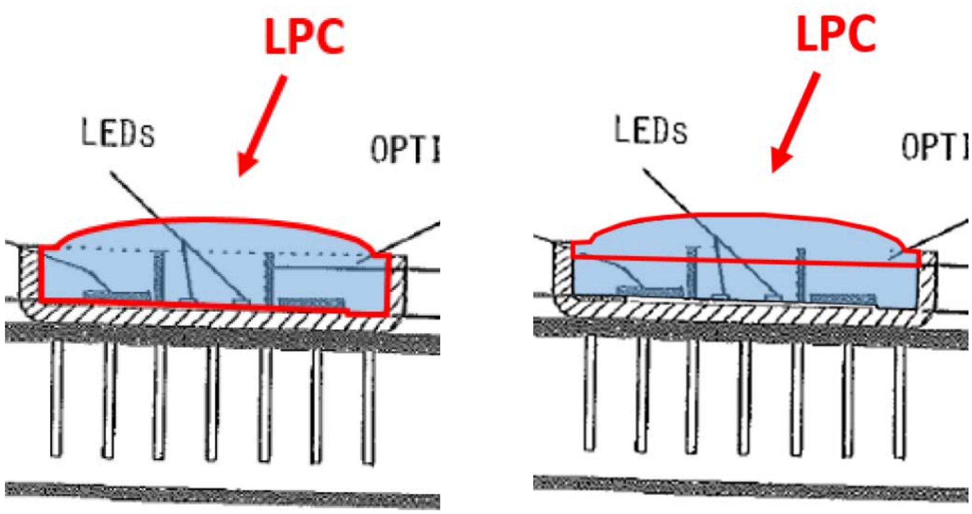
Petitioner asserts Mendelson-1988 describes its cover as an optically clear epoxy, but it "does not provide additional details . . . regarding the precise shape of this layer's interface with the skin."[12] Pet. 67–68 (citing Ex. 1015, 168, 173); Ex. 1003 ¶ 173. Petitioner asserts "a POSITA would have sought to incorporate an Inokawa-like lens into the cover of Mendelson-1988 to increase the light collection efficiency, which in turn would lead to an improved signal-to-noise ratio (and thus more reliable pulse [sic SpO_2] detection)." Pet. 68–69; Ex. 1003 ¶ 175. Petitioner asserts: "A POSITA would have been particularly interested in making such a modification because Mendelson-1988 is expressly interested in maximizing 'reflectance photoplethysmographic signals.'" Pet. 69 (citing Ex. 1015, 173); Ex. 1003 ¶ 175. Petitioner's theory for obviousness is otherwise substantially the same as discussed above in Ground 1A, with Mendelson-1988 replacing Aizawa, including some reliance on Nishikawa. Pet. 69–71, 76; Ex. 1003 ¶¶ 175–179. For example, Dr. Kenny provides the following illustrations to portray the proposed modification of Mendelson-1988's sensor (Ex. 1003 ¶¶ 180–181):

[12] Petitioner overstates the paucity of Mendelson-1988's disclosure here. Mendelson-1988 illustrates the epoxy as having a flat surface, which Dr. Kenny notes in his testimony. *See* Ex. 1014, Fig. 2B; Ex. 1003 ¶ 176.



At the left, Dr. Kenny has excerpted and annotated Mendelson-1988's Figure 2B, to identify the pre-existing cover (colored blue) which covers the light emitters and detectors. *See* Ex. 1003 ¶ 176. At the right, Dr. Kenny has illustrated the device resulting from the proposed modification of the cover to have a convex protrusion (colored blue). *See id.*

Petitioner further asserts "there are two alternative ways of mapping the claimed 'light permeable cover,' or LPC, to the modified cover above." Pet. 77; Ex. 1003 ¶ 180. Dr. Kenny provides the following two illustrations, annotating Mendelson-1988's Figure 2B, to identify these alternative mappings:



Dr. Kenny's first mapping (at the left) equates the cover to the entire depth of the epoxy contained within the AIRPAX package as shown in red outline, whereas Dr. Kenny's second mapping (at the right) equates the cover to a partial depth of the epoxy within the package as shown in red outline, which Dr. Kenny identifies as "just the lens portion . . . that is formed over the underlying sealing portion . . . as informed by Nishikawa." Pet. 77–78 (citing Ex. 1001, Fig. 14D; Ex. 1023, Figs. 5–6, ¶¶ 34–38); Ex. 1003 ¶¶ 180–181.

Petitioner adds that "a POSITA would have realized that the epoxy layer could have been given a shape that would help further advance Mendelson-1988's objective of improving detection efficiency," "requir[ing] only routine knowledge of sensor design and assembly." Pet. 68, 70 (citing Ex. 1015, 168, 173); Ex. 1003 ¶¶ 173, 177. For example, "as demonstrated by Nishikawa, molding clear epoxy, as in Mendelson-1988, into a lens shape was well understood." Pet. 70–71 (citing Ex. 1023, Fig. 6, ¶¶ 22, 32, 35, 37); Ex. 1003 ¶¶ 178–179. Also according to Petitioner: "Nishikawa expressly discloses that any gaps between the encapsulation and lens portions [i.e., sealing portion 40 and lens unit 50 in Nishikawa's Figure 6] can be minimized by fusing the two portions at the interface to improve optical performance." Pet. 70–71 (citing Ex. 1023 ¶ 37, Fig. 6); Ex. 1003 ¶ 179.

(2) Patent Owner's Contentions

Patent Owner asserts Petitioner has not met its burden to demonstrate the obviousness of modifying Mendelson-1988's sensor in light of Inokawa to have a convex protrusion, based on substantially the same analysis and

testimony discussed above in the context of combining Aizawa and Inokawa. *See* PO Resp. 44–49; Ex. 2004 ¶¶ 98–110; *supra* Section III.D.3(c)(2). For example, Mendelson-1988 like Aizawa provides a central emitter or emitters surrounded by several detectors. *Compare* Ex. 1015, 169 (Fig. 2) (showing four central LEDs surrounded by six photodiodes), *with* Ex. 1006, Figs. 1(a)–1(b) (showing one central LED 21 surrounded by four photodetectors 22).

Patent Owner also objects to Petitioner's alternative mapping, providing for a cover with a protrusion to be found in two different ways. *See* PO Resp. 51–53; Ex. 2004 ¶¶ 115–117. This alternative mapping, in Patent Owner's view, is "ambiguous[]," and the second mapping "arbitrarily" draws a line defining the bottom of the cover in "an ***undifferentiated*** mass of material." PO Resp. 52–53. Patent Owner also argues "Petitioner's inability to consistently identify a 'cover' reveals the hindsight-driven nature of its arguments," especially as they relate to dependent claim 3. *Id.* at 52–53.

Patent Owner moreover asserts Petitioner errs in relying on Nishikawa as supporting the unpatentability of claim 1, because Nishikawa is not identified as part of Ground 2A which instead "includes only two references," Mendelson-1988 and Inokawa. PO Resp. 58–59 (citing Pet. 2, 70, 77–78, 80; Ex. 2007, 364:2–13; Ex. 2008, 73:8–12); Ex. 2004 ¶ 126. Patent Owner also asserts Petitioner's reliance on Nishikawa "makes no sense" based on substantially the same analysis and testimony discussed above in the context of combining Aizawa and Inokawa. PO Resp. 59; Ex. 2004 ¶ 127. Patent Owner argues Petitioner improperly relies on Nishikawa "to fill missing gaps [in Mendelson-1988 and Inokawa], not as

evidence of general knowledge in the art," thereby attempting to "sidestep the requirements to establish a motivation and expectation of success." PO Resp. 59–60 (citing Pet. 70; *K/S HIMPP v. Hear-Wear Technologies, LLC*, 751 F.3d 1362, 1366 (Fed. Cir. 2014)); Ex. 2004 ¶ 129.

(3) Petitioner's Reply

In reply, Petitioner provides substantially the same analysis and testimony discussed above in the context of combining Aizawa and Inokawa. *See* Pet. Reply 26; Ex. 1047 ¶ 54. Petitioner also maintains that both of Dr. Kenny's alternative mappings of the claimed "cover" to Mendelson-1988 are justified. Pet. Reply 28–29; Ex. 1047 ¶¶ 59–60. Petitioner further asserts its reliance on Nishikawa is not improper. Pet. Reply 32; Ex. 1047 ¶ 64.

(4) Patent Owner's Sur-reply

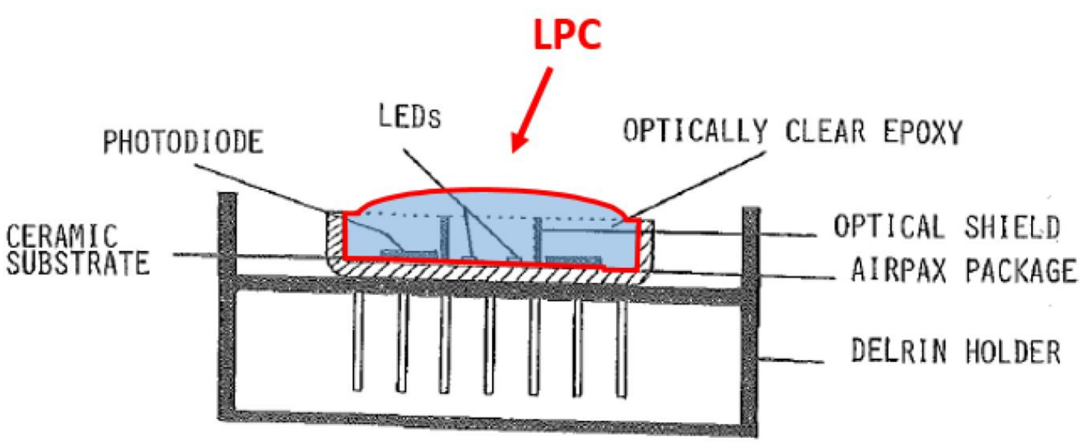
Patent Owner's sur-reply reiterates Patent Owner's arguments against Petitioner's contentions of the obviousness of modifying Mendelson-1988's sensor to include a convex protrusion. *See* Sur-reply 21, 23–24.

(5) Analysis and Conclusion

Upon review of the foregoing, we conclude a preponderance of the evidence supports Petitioner's contention that a POSITA would have been motivated to modify the top surface of Mendelson-1988's cover to include a convex protrusion, in light of Inokawa, in order to increase the amount of backscattered light that will be received by the six peripheral detectors, versus the existing flat cover surface. Our reasoning is substantially identical to the analysis provided above in connection with Ground 1A, with

Mendelson-1988 replacing Aizawa in the combination. *See supra* Section III.D.3(c)(2). Patent Owner does not cite, and we do not discern, any material difference between Mendelson-1988 and Aizawa that might lead to a different result here, with two possible exceptions.

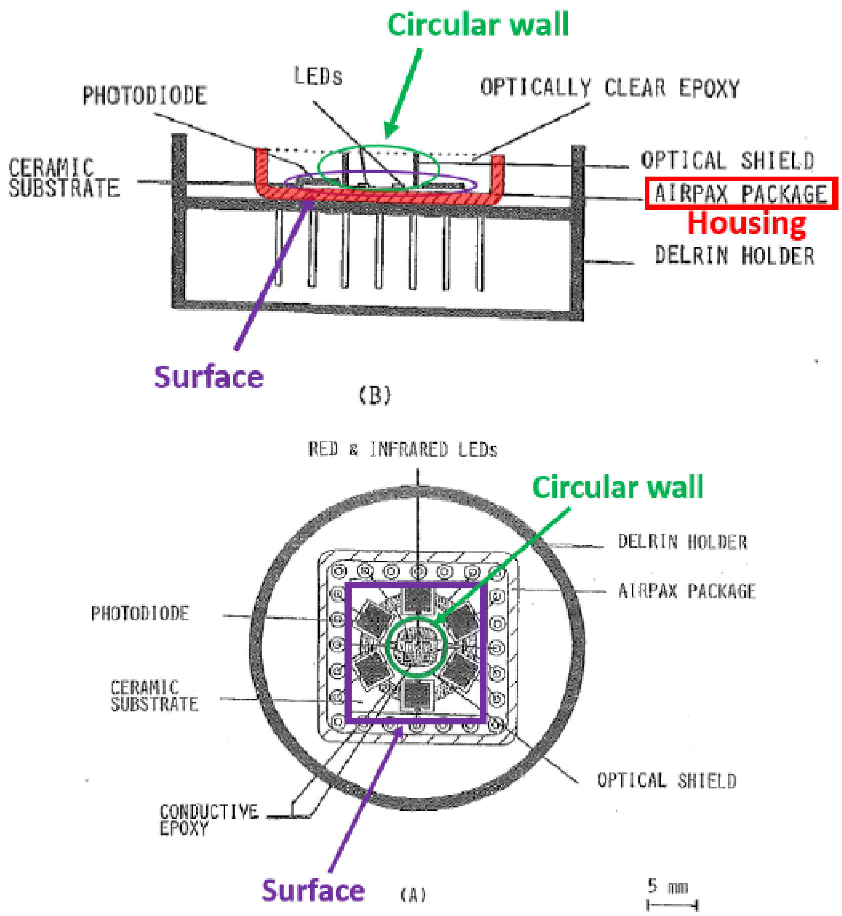
The first difference is Petitioner's alternative mapping of the claimed "cover" to Petitioner's proposed modification of Mendelson-1988's sensor. We rely on the first mapping, but not the second mapping, to decide in Petitioner's favor. Petitioner's first mapping is reproduced here (Ex. 1003 ¶ 180):



In this modified and annotated version of Figure 2B of Mendelson-1988, Dr. Kenny identifies how Mendelson-1988's light permeable cover ("LPC") may be modified to have a protrusion in light of Inokawa, wherein the cover (which Dr. Kenny has colored blue) includes the entire depth of the optically clear epoxy contained within the AIRPAX package (as Dr. Kenny has shown in red outline). Ex. 1003 ¶ 180; Pet. 77. Patent Owner objects to this mapping as ambiguous, but we determine Dr. Kenny's annotations reproduced above are sufficiently clear to establish obviousness by a preponderance of the evidence.

The second difference between Grounds 1A and 2A relates to claim 1's requirement of "a housing having a surface and a circular wall protruding from the surface." Ex. 1001, 45:5–6. In Ground 2A, Petitioner addresses this limitation in two, alternative, ways.

First, as explained above in Section III.I.2(a), we find Mendelson-1988's sensor exhibits such a housing, as Petitioner contends in the Petition at pages 72–73. Petitioner's annotations to Mendelson-1988's Figure 2 illustrate the basis for this finding, and are reproduced below.



Here, Mendelson-1988's Figures 2(A) and 2(B) have been annotated to identify the "circular wall" in green and the "surface" of the housing in purple. Patent Owner does not object to the Petition's contentions in this

regard, which we find are supported by a preponderance of the evidence. *See, e.g.*, PO Resp. 53–58; Ex. 2004 ¶ 100 ("Mendelson-1988 includes a ring-shaped optical shield surrounding the LEDs . . . .").

Second and "[a]lternatively," Petitioner contends "the outer wall of the AIRPAX microelectronic package" in Mendelson-1988, which is square as shown by the red annotations in Figure 2(B) above, "can be modified to be a circular wall," and thereby satisfy this limitation of claim 1 in a different way. Pet. 73–75; Ex. 1003 ¶¶ 168–170. Patent Owner objects to this alternative contention. *See* PO Resp. 56–58; Ex. 2004 ¶¶ 100, 122–125. For reasons provided below in Section III.I.3 in relation to claim 26, this alternative obviousness contention also is supported by a preponderance of the evidence.

d) Conclusion as to Claim 1

Based on the foregoing arguments and evidence, we conclude Petitioner has demonstrated by a preponderance of the evidence that claim 1 is unpatentable as having been obvious over Mendelson-1988 and Inokawa.

3. Claim 26

Petitioner provides arguments and evidence, including testimony from Dr. Kenny, in support of contending claim 26 is unpatentable as having been obvious over Mendelson-1988 and Inokawa. Pet. 89–92; Ex. 1003 ¶¶ 211–219. Much of Petitioner's analysis for claim 26 is substantially the same as for claim 1, which as discussed above in Section III.I.2 is persuasive.

Claim 26 differs from claim 1 in specifying "a circular housing comprising a surface with a raised edge." *Compare* Ex. 1001, 45:5–6 (claim 1), *with id.* at 46:52–53 (claim 26). Petitioner correspondingly asserts

Mendelson-1998 includes a "housing" as the AIRPAX package. *See* Pet. 90 (annotating Mendelson-1988's Figures 2A–2B to identify the "Housing" in green); Ex. 1003 ¶¶ 213–214. This housing has "a square shape" rather than the "circular" shape required by claim 26. Pet. 90–91; Ex. 1003 ¶ 215.

Petitioner contends "a POSITA would have recognized that microelectronic packaging as used in Mendelson-1988 comes in various shapes and sizes," including a circular shape as demonstrated by Mendelson '799[13]. Pet. 91 (citing Ex. 1025, Fig. 7, 9:34–36); Ex. 1003 ¶ 215. Petitioner asserts "[a] POSITA would have considered using a differently shaped housing, namely a circular one, to be obvious," because this "was common practice well before the ['265 patent], and there was nothing new or inventive about changing one housing shape for another." Pet. 73–75, 91; Ex. 1003 ¶¶ 168–170, 216.

Patent Owner objects that "just because something 'can' be modified does not mean a POSITA would have been motivated to do so," and Petitioner "never identifies a motivation to pick a circular-shaped wall instead of the existing square shape" in Mendelson-1988. PO Resp. 57 (citing *InTouch Techs., Inc. v. VGo Commc'ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014)); Ex. 2004 ¶ 124. According to Patent Owner, "[a] POSITA would have no particular motivation to change the shape unless a POSITA perceived some benefit in doing so." PO Resp. 57; Ex. 2004 ¶ 124.

Patent Owner asserts Petitioner errs in relying on Mendelson '799 as supporting the unpatentability of claim 26, because Mendelson '799 is not

[13] Exhibit 1025, US 6,801,799 B2, issued Oct. 5, 2004.

identified as part of Ground 2A which instead "includes only two references," Mendelson-1988 and Inokawa. PO Resp. 57–59 (citing Pet. 1–2, 73–75). Patent Owner also asserts Petitioner improperly relies on Mendelson '799 "to fill missing gaps [in Mendelson-1988 and Inokawa], not as evidence of general knowledge in the art," thereby attempting to "sidestep the requirements to establish a motivation and expectation of success." PO Resp. 59–60 (citing Pet. 75; *K/S HIMPP*, 751 F.3d at 1366); Ex. 2004 ¶ 129.

On the merits of Mendelson '799, Patent Owner argues the reference does not support Dr. Kenny's testimony that "using a circular housing having a circular wall . . . was common practice" (Ex. 1003 ¶¶ 168–170), because it "never mentions or suggests a housing with a wall or raised edge." PO Resp. 57; Ex. 2004 ¶¶ 125, 128–129 (citing Ex. 1025, 9:22–40, Fig. 7).

Petitioner replies that "references like Mendelson [']799 have a circular wall/housing and confirm the notion that a POSITA would have found it to be simply a matter of design choice to use different shapes." Pet. Reply 31 (citing Ex. 1025, Fig. 7, 9:34–36); Ex. 1047 ¶ 63. Petitioner also asserts "neither the '265 patent nor [Patent Owner] provides any explanation of how the particular housing shape solves some problem or presents some unexpected result." Pet. Reply 31 (citing *In re Kuhle*, 526 F.2d 553, 555 (CCPA 1975)).

Patent Owner responds that "Petitioner's reply reiterates its conclusory arguments that [the proposed] change would be routine, without identifying any reason to modify the shape from square to circular." Sur-reply 24–25.

Upon review of the foregoing, we conclude a preponderance of the evidence supports Petitioner's contention that it would have been obvious to modify the shape of Mendelson-1988's AIRPAX package from square to circular. Figure 7 of Mendelson '799 is reproduced below:

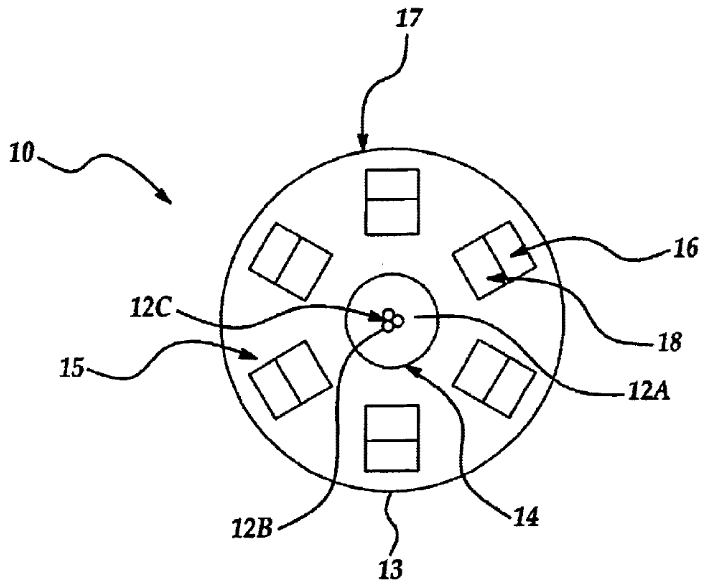


Figure 7

Figure 7 is a top view of optical sensor 10 comprising light source 12 composed of three LEDs 12A, 12B, and 12C emitting light of three different wavelengths, and an array of six near detectors 18 and six far detectors 16 "arranged in two concentric ring-like arrangements" surrounding light source 12. Ex. 1025, 9:23–34. "All these elements are accommodated in a sensor housing 17," which as can be seen in Figure 7, is circular. *Id.* at 9:34–35.

A POSITA would recognize that the AIRPAX package of Mendelson-1988 and the housing 17 of Mendelson '799 are performing the same function of enclosing a central collection of light emitters which are surrounded by an array of light detectors in an optical sensor attached to a user's body. *See, e.g.*, Ex. 1015, Figs. 2A–2B; Ex. 1025, Fig. 7. Also, the

evidence of record does not suggest that the shape of such a housing has any functional significance in the operation of the optical sensor. Thus, the evidence suggests that a square shape and a circular shape of such as housing were known in the art to be predictable substitutes for one another, and therefore obvious variants. *See, e.g.*, *KSR*, 550 U.S. at 416 ("[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result."); *id.* at 417 ("[W]hen a patent 'simply arranges old elements with each performing the same function it had been known to perform' and yields no more than one would expect from such an arrangement, the combination is obvious." (citation omitted)).

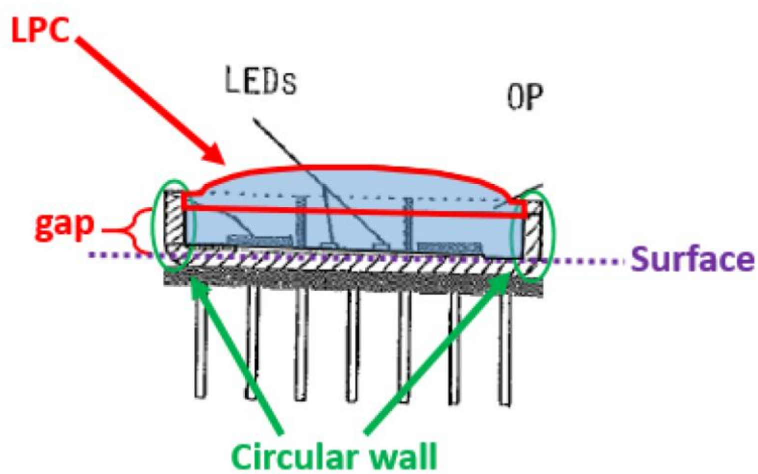
We further conclude Petitioner's reliance on Mendelson '799 is not improper simply because Mendelson '799 is not listed as a reference in Petitioner's identification of Ground 2A with Mendelson-1988 and Inokawa. *See* Pet. 2, 66. This would exalt form over substance, which we decline to do. The nature of Petitioner's reliance on Mendelson '799 as evidence of the understanding of a person of ordinary skill in the art, in support of Ground 2A, is explained clearly in the Petition. *See id.* at 73–75, 91. Thus, the Petition complies with 35 U.S.C. § 312(a)(3).

We conclude Petitioner has demonstrated by a preponderance of the evidence that claim 26 is unpatentable as having been obvious over Mendelson-1988 and Inokawa.

4. Claims 3, 6–13, and 16

Claim 3 depends indirectly from claim 1 to add "the circular wall creates a gap between the surface and the light permeable cover." Ex. 1001, 45:16–22 (claims 2 and 3); Ex. 1002, 351 (Certificate of Correction changing "cove" to "cover" in claim 3). Claims 6–13 and 16 depend, directly or indirectly, from claim 3. *See id.* at 45:30–61, 46:4–7.

For claim 3, Petitioner relies solely on Dr. Kenny's second mapping of the claimed "cover" to Petitioner's proposed modification of Mendelson-1988's sensor. *See* Pet. 79–80; Ex. 1003 ¶ 184. This is shown by Dr. Kenny in the following illustration (Ex. 1003 ¶ 184):



In this modified and annotated version of Figure 2B of Mendelson-1988, Dr. Kenny identifies how Mendelson-1988's light permeable cover ("LPC") may be modified to have a protrusion, wherein the cover includes "only the lens portion, which lies above the underlying sealing portion" in a "two-part structure . . . as in Nishikawa." Ex. 1003 ¶¶ 178–181 (citing Ex. 1023, Figs. 5–6, ¶¶ 22, 32, 34–38) (addressing claim 1); *id.* ¶¶ 184–186 (addressing claim 3). Dr. Kenny's annotations also identify how this second mapping provides a "gap" between the "Surface" of the housing and the

cover. In support, Dr. Kenny cites a dictionary definition of the term "gap" as meaning "a separation in space." *Id.* ¶ 185; Pet. 80; Ex. 1017 (*Merriam-Webster's Collegiate Dictionary*, 11th ed. (©2005)), 515 (definition 4a). Dr. Kenny additionally finds "the size of the gap . . . would be defined, in part, by" the AIRPAX package wall which he has annotated in green, because that wall "surrounds the epoxy structure and serves as a mold that define[s] its overall height and, by extension, the size of the gap." Ex. 1003 ¶ 186.

Patent Owner objects that Petitioner's second mapping "arbitrarily" draws a line defining the bottom of the cover in "an ***undifferentiated*** mass of material." PO Resp. 52–54 (citing Ex. 2007, 355:12–359:5); Ex. 2004 ¶¶ 115–120. In Patent Owner's view, this "does not create a 'gap'" between the surface of the housing and the cover. PO Resp. 53–54; Ex. 2004 ¶¶ 117, 120. Patent Owner asserts "the 'gap' of claim 3 requires a 'break' . . . between the cover and the surface," and "[t]here is no such 'break' in Petitioner's combination." PO Resp. 54 (citing Ex. 1001, 36:45–49, Fig. 14D; Ex. 1017, 515 (definition 1a) ("a break in a barrier")); Ex. 2004 ¶¶ 118, 120. Patent Owner additionally asserts Petitioner's second mapping does not establish that the AIRPAX package wall "***creates*** a gap between the surface and the light permeable cover," as recited in claim 3, because the AIRPAX package wall "does not correspond to the size of any gap" and "extends beyond Petitioner's alleged 'gap.'" PO Resp. 55; Ex. 2004 ¶ 121.

Petitioner replies that "the 'line' between the LPC/cover and the epoxy encapsulation layer underneath is not arbitrary, instead being formed, for instance, by a common manufacturing technique" disclosed by Nishikawa. Pet. Reply 30; Ex. 1047 ¶ 62. Petitioner also argues "the height

of [the AIRPAX package wall] necessarily impacts the position of the cover, in turn impacting the size of the 'gap' between the cover and the surface." Pet. Reply 30; Ex. 1047 ¶ 62.

Patent Owner's sur-reply reiterates the arguments on this issue. *See* Sur-reply 24.

Upon review of the foregoing, we conclude Petitioner's case for the obviousness of claim 3 falls short. Petitioner's identification of the bottom border of the "cover" in Petitioner's second mapping is arbitrary, and is not supported by a preponderance of the evidence. In particular, this is not "how a POSITA would have understood a 'cover' structure" to be found in Mendelson-1988. Ex. 2004 ¶ 117. Dr. Kenny does not provide any persuasive reasoning in support of his definition of the "cover" as ending at the bottom border he has identified. *See* Ex. 1003 ¶¶ 178–181, 184–186; Ex. 1047 ¶¶ 61–62; Ex. 2007, 355:12–359:5. We perceive no such reasoning, apart from an impermissible hindsight desire to shoehorn Mendelson-1988's disclosure into the confines of claim 3.

Dr. Kenny relies on Nishikawa in this regard. Figure 6 of Nishikawa is reproduced below:

FIG. 6

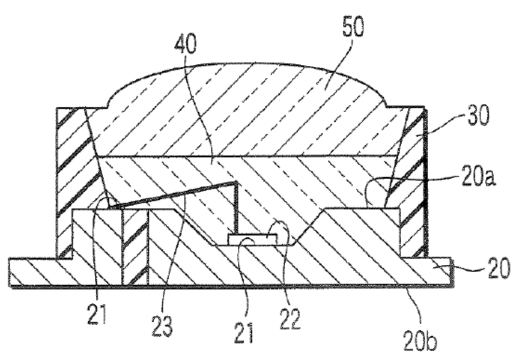


Figure 6 is a sectional view of a lens-equipped light-emitting diode device, including sealing portion 40 that "seals a light-emitting diode 22 and a

bonding wire 23," and lens unit 50. Ex. 1023 ¶¶ 22, 30. Sealing portion 40 and lens unit 50 may both comprise "[a] thermosetting resin or a UV curing resin, such as a transparent epoxy resin and transparent silicone." *Id.* ¶ 32. Dr. Kenny relies on Nishikawa's disclosure that sealing portion 40 and lens unit 50 may be formed in separate injection molding steps, leading to a defined border between them which is shown as a horizontal line in Figure 6. *Id.* ¶¶ 34–35. Thus, Nishikawa does establish, as Dr. Kenny testifies, that Mendelson-1988's epoxy layer *could* have been formed in a two-step injection molding process, leading to a border between two layers of epoxy. *See* Ex. 1003 ¶¶ 178–179, 181, 186; Ex. 1047 ¶ 62.

However, Dr. Kenny errs in "focus[ing] on what a skilled artisan would have been *able* to do, rather than what a skilled artisan would have been *motivated* to do." *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1068–69 (Fed. Cir. 2018) (citing *InTouch*, 751 F.3d at 1352). Dr. Kenny does not provide any persuasive motivation for using Nishikawa's two-step molding process within the context of Mendelson-1988's sensor. Thus, we conclude Dr. Kenny "succumbed to hindsight bias in [his] obviousness analysis." *InTouch*, 751 F.3d at 1352.

Further, even if we were to accept Dr. Kenny's testimony of a "gap" being present in Mendelson-1988 by Nishikawa's two-step injection molding process, we are not persuaded that the AIRPAX package wall "creates" this gap as is further recited in claim 3. *See* Ex. 1003 ¶ 186; Ex. 1047 ¶ 62. Dr. Kenny testifies in support that "the size of the gap . . . would be defined, in part, by" the wall, which "serves as a mold that define[s] [the gap's] overall height and, by extension, the size of the gap." Ex. 1003 ¶ 186. This testimony is belied by Dr. Kenny's own illustration, in

which the bottom border of the "cover" is located *underneath* the top edge of the AIRPAX package wall. *See id.* ¶ 184. In no way does the AIRPAX package wall create the gap. Instead, the gap is created by the height of the lower layer of epoxy laid down in Nishikawa's first injection molding step. *See* Ex. 1047 ¶ 62.

For the foregoing reasons, we conclude Petitioner has not demonstrated by a preponderance of the evidence that claim 3, and its dependent claims 6–13 and 16, are unpatentable as having been obvious over Mendelson-1988 and Inokawa.

5. Claims 2, 4, 14, 17–22, and 27–30

Petitioner provides arguments and evidence, including testimony from Dr. Kenny, in support of contending claims 2, 4, 14, 17–22, and 27–30 are unpatentable as having been obvious over Mendelson-1988 and Inokawa. Pet. 78–79, 80–81, 86, 87–89, 92–95; Ex. 1003 ¶¶ 182–183, 188, 203, 205–210, 218–226. In defense of these claims, Patent Owner relies solely on arguments relating to independent claims 1 and 26. *See*, *e.g.*, PO Resp. 60. For the reasons provided in Sections III.I.2 and III.I.3 above in relation to claims 1 and 26, we conclude Patent Owner's defense is unavailing.

Concerning dependent claims 2, 4, 14, 17–22, and 27–30, we find a preponderance of the evidence supports Petitioner's contentions that Mendelson-1988's sensor exhibits the limitations recited in these claims, applying Dr. Kenny's first mapping of the claimed "cover," or that such limitations would have been obvious to implement in Mendelson-1988,

based on the evidence cited and the reasons provided in the Petition, which we adopt as our own here. *See* Pet. 78–79, 80–81, 86, 87–89, 92–95.

Thus, we conclude Petitioner has demonstrated by a preponderance of the evidence that claims 2, 4, 14, 17–22, and 27–30 are unpatentable as having been obvious over Mendelson-1988 and Inokawa.

J. Ground 2B — Obviousness over Mendelson-1988, Inokawa, and Mendelson-2006

In Ground 2B, Petitioner argues claims 23 and 24 of the ’265 patent would have been obvious over Mendelson-1988, Inokawa, and Mendelson-2006. Pet. 2, 95–98. This ground is essentially a combination of Grounds 1C and 2A discussed above, with Aizawa being replaced by Mendelson-1988. Patent Owner’s opposition to this Ground 2B relies solely on arguments presented against Grounds 1C and 2A, which are discussed above. *See* PO Resp. 60. For reasons provided above in connection with those grounds, we conclude Petitioner has demonstrated by a preponderance of the evidence that claims 23 and 24 are unpatentable as having been obvious over Mendelson-1988, Inokawa, and Mendelson-2006.

K. Ground 2C — Obviousness over Mendelson-1988, Inokawa, Mendelson-2006, and Beyer

In Ground 2C, Petitioner argues claim 25 of the ’265 patent would have been obvious over Mendelson-1988, Inokawa, Mendelson-2006, and Beyer. Pet. 2, 98–99. This ground is essentially a combination of Grounds 1E and 2A discussed above, with Aizawa being replaced by Mendelson-1988. Patent Owner’s opposition to this Ground 2C relies solely on arguments presented against Grounds 1E and 2A, which are discussed above. *See* PO Resp. 60. For reasons provided above in connection with

those grounds, we conclude Petitioner has demonstrated by a preponderance of the evidence that claim 25 is unpatentable as having been obvious over Mendelson-1988, Inokawa, Mendelson-2006, and Beyer.

IV. SUMMARY OF CONCLUSIONS

In summary, we determine a preponderance of the evidence establishes claims 1–4, 6–14, and 16–30 of the ’265 patent are unpatentable, as shown in the following table:[14]

Claim(s)	35 U.S.C. §	References	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–4, 6–14, 16, 17, 19–23, 26–29	103	Aizawa, Inokawa	1–4, 6–14, 16, 17, 19–23, 26–29	
1–4, 6–14, 16, 17, 19–23, 26–29	103	Aizawa, Inokawa, Ohsaki	1–4, 6–14, 16, 17, 19–23, 26–29	
23, 24	103	Aizawa, Inokawa, Mendelson-2006	23, 24	

[14] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

23, 24	103	Aizawa, Inokawa, Goldsmith, Lo[15]		
25	103	Aizawa, Inokawa, Mendelson-2006, Beyer	25	
1–4, 6–14, 16–22, 26–30	103	Mendelson-1988, Inokawa	1, 2, 4, 14, 17–22, 26–30	3, 6–13, 16
23, 24	103	Mendelson-1988, Inokawa, Mendelson-2006	23, 24	
25	103	Mendelson-1988, Inokawa, Mendelson-2006, Beyer	25	
Overall Outcome			1–4, 6–14, 16–30	

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–4, 6–14, and 16–30 of the ’265 patent have been proven by a preponderance of the evidence to be unpatentable; and

FURTHER ORDERED that, because this is a final written decision, parties to this proceeding seeking judicial review of our Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

[15] As explained above in Section III.G, we do not reach this ground, to conserve the Board’s resources in considering multiple challenges to claims 23 and 24.

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U.S. DEPARTMENT OF COMMERCE
UNITED STATES PATENT AND TRADEMARK OFFICE

May 23, 2022

THIS IS TO CERTIFY that the attached document is a list of the papers that comprise the record before the Patent Trial and Appeal Board (PTAB) for the *Inter Partes* Review proceeding identified below.

APPLE INC.,

Petitioner,

v.

MASIMO CORPORATION,

Patent Owner.

Case No.: IPR2020-01521
United States Patent No.: 10,292,628 B1

By authority of the
DIRECTOR OF THE UNITED STATES
PATENT AND TRADEMARK OFFICE

/s/ Mekbib Solomon
Certifying Officer

PROSECUTION HISTORY FOR *INTER PARTES* REVIEW NO.: IPR2020-01521

DATE	DESCRIPTION
09/02/2020	Petition for *Inter Partes* Review
09/02/2020	Petitioner's Power of Attorney
09/21/2020	Patent Owner's Mandatory Notices
10/19/2020	Notice of Filing Date Accorded
01/08/2021	Petitioner's Updated Exhibit List
01/19/2021	Patent Owner's Notice of Waiver of Preliminary Response
04/14/2021	Decision - Institution of *Inter Partes* Review Proceeding
04/14/2021	Scheduling Order
04/28/2021	Patent Owner's Objection to Evidence
05/20/2021	Petitioner's Motion to Submit Supplemental Information
05/26/2021	Order Granting Petitioner's Motion to Submit Supplemental Information
06/01/2021	Petitioner's Submission of Supplemental Information
06/15/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
06/28/2021	Patent Owner's Amended Notice of Deposition - Thomas W. Kenny
07/09/2021	Patent Owner's Response
07/16/2021	Petitioner's Objections to Evidence
10/01/2021	Petitioner's Reply to Patent Owner's Response
10/08/2021	Patent Owner's Objection to Evidence
10/20/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
11/12/2021	Patent Owner's Sur Reply
11/19/2021	Petitioner's Objections to Evidence
12/02/2021	Petitioner's Oral Hearing Request
12/03/2021	Patent Owner's Request for Oral Argument
12/14/2021	Petitioner's Updated Mandatory Notices
12/17/2021	Order Setting Oral Argument
12/21/2021	Patent Owner's Updated Mandatory Notice
01/07/2022	Patent Owner's Updated Mandatory Notice
01/10/2022	Petitioner's Updated Mandatory Notices
01/14/2022	Patent Owner's Demonstratives for Trial Hearing
01/14/2022	Petitioner's Updated Exhibit List
02/16/2022	Oral Hearing Transcript
04/11/2022	Final Written Decision
04/12/2022	Notice of Appeal

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571-272-7822

Paper 33
Date: April 11, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

IPR2020-01521
Patent 10,292,628 B1

Before JOSIAH C. COCKS, ROBERT L. KINDER, and AMANDA F. WIEKER, *Administrative Patent Judges.*

COCKS, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

Apple Inc. ("Petitioner") filed a Petition (Paper 2, "Pet.") pursuant to 35 U.S.C. §§ 311–319 to institute an *inter partes* review of claims 1–30 ("challenged claims") of U.S. Patent No. 10,292,628 B1 (Ex. 1001, "the '628 patent"). We instituted the petitioned review (Paper 7, "Institution Decision" or "Inst. Dec.").

Masimo Corporation ("Patent Owner") filed a Patent Owner Response (Paper 15, "PO Resp.") to oppose the Petition. Petitioner filed a Reply (Paper 17, "Pet. Reply") to the Patent Owner Response. Patent Owner filed a Sur-reply (Paper 20, "Sur-reply") to the Reply. We conducted an oral hearing on January 19, 2022. A transcript has been entered into the record (Paper 32, "Tr.").

We have jurisdiction under 35 U.S.C. § 6(b)(4) and § 318(a). This Decision is a final written decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as to the patentability of claims 1–30 of the '628 patent. We determine Petitioner has shown by a preponderance of the evidence that those claims are unpatentable.

B. Related Matters

The parties identify the following matters related to the '628 patent:

Masimo Corporation v. Apple Inc., Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

Apple Inc. v. Masimo Corporation, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2); and

Apple Inc. v. Masimo Corporation, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2).

Pet. 98, Paper 3, 1.

Patent Owner further identifies numerous issued and abandoned applications that are said to claim priority to, or share a priority claim with, the ’628 patent. Paper 3, 3.

C. The ’628 Patent

The ’628 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on May 21, 2019, from U.S. Patent Application No. 16/261,326, filed January 29, 2019. Ex. 1001, codes (21), (22), (45), (54). The ’628 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:31–33. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to

measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:55–3:5. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:38–40.

Figure 1 of the '628 patent is reproduced below.

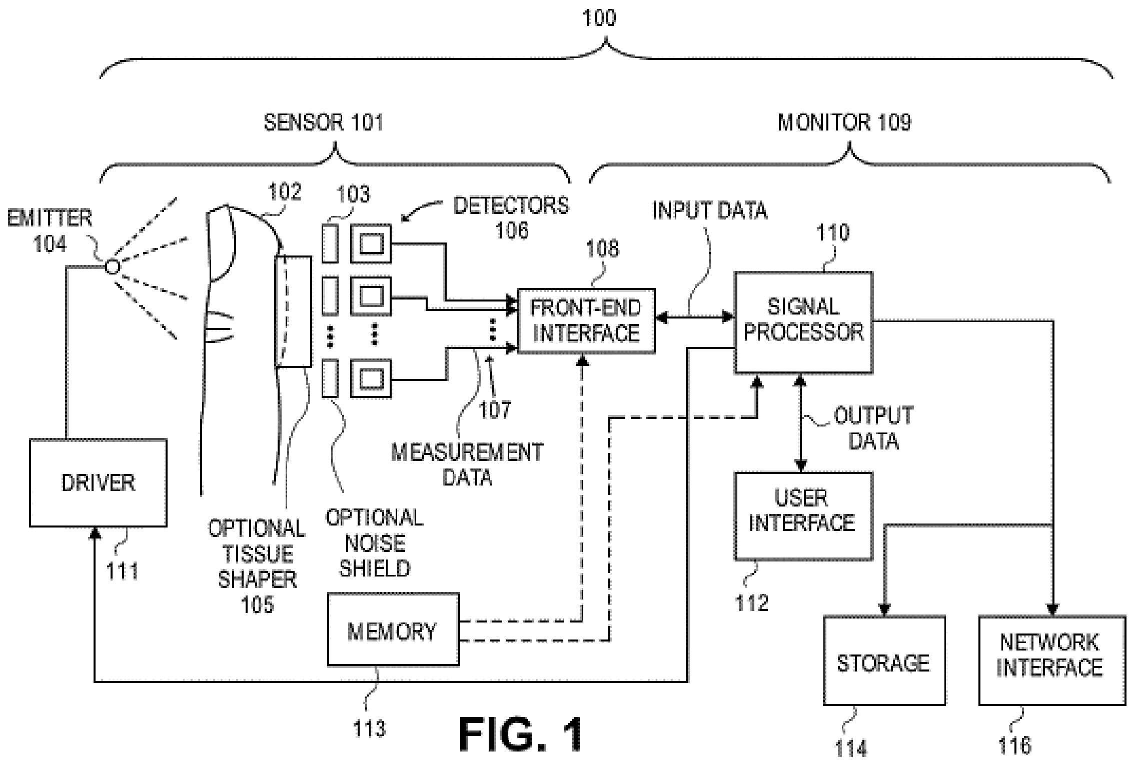


FIG. 1

Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 5:26–29, 11:36–37. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* at 11:48–50. Emitters 104 emit light that is attenuated or reflected by the patient's tissue at measurement site 102. *Id.* at 13:60–64. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light, detectors 106 output detector signals 107 to monitor 109 through front-end interface 108. *Id.* at 13:64–67, 14:16–22. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that:

(1) reduces the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 10:51–11:3.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:6–8. "[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals received from the detectors 106." *Id.* at 15:10–14. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:38–42. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 15:52–16:3.

The '628 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate sensor devices.

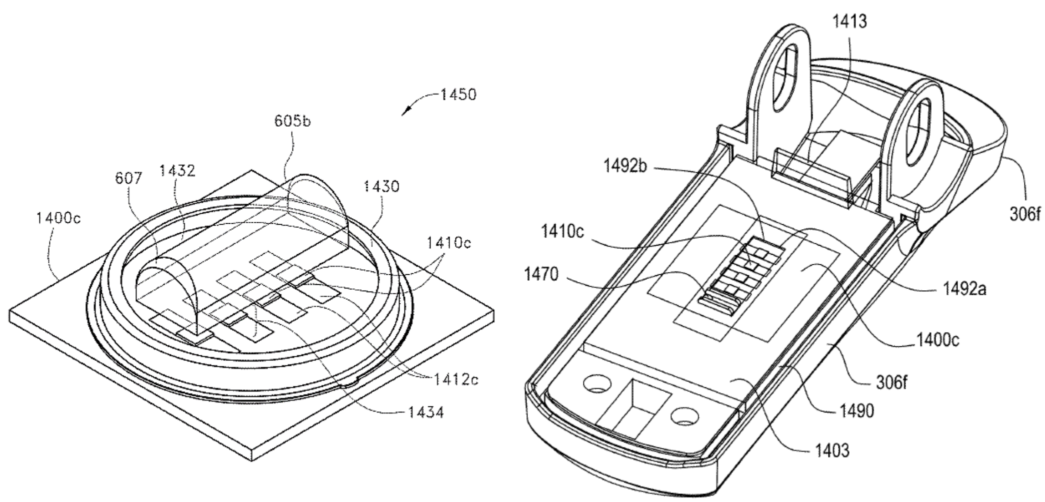


FIG. 14D **FIG. 14F**

Figure 14D illustrates portions of a detector submount and Figure 14F illustrates portions of a detector shell. *Id.* at 6:34–37. As shown in Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 36:15–35. Figure 14F illustrates a detector shell 306f including detectors 1410c on substrate 1400c.

Id. at 36:62–37:3. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* Alternatively, cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:34–36.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.

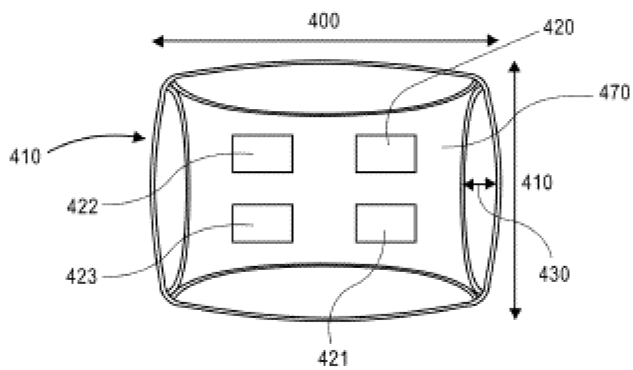


FIG. 4A

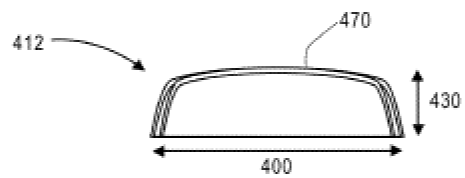


FIG. 4B

Figures 4A (left) and 4B (right) illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:8–14. "[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site." *Id.* "For example, the measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site." *Id.* at 23:31–33. The measurement site contact area may include windows 420–423 that "mimic or approximately mimic a configuration of, or even house, a plurality of detectors." *Id.* at 23:39–53.

D. Illustrative Claim

Of the challenged claims, claims 1, 7, and 20 are independent. Claim 1 is illustrative and is reproduced below.

1. A noninvasive optical physiological sensor comprising:

> [a] a plurality of emitters configured to emit light into tissue of a user;
>
> [b] a plurality of detectors configured to detect light that has been attenuated by tissue of the user, wherein the plurality of detectors comprises at least four detectors;
>
> [c] a housing configured to house at least the plurality of detectors; and
>
> [d] a light permeable cover configured to be located between tissue of the user and the plurality of detectors when the noninvasive optical physiological sensor is worn by the user, wherein the cover comprises an outwardly protruding convex surface configured to cause tissue of the user to conform to at least a portion of the outwardly protruding convex surface when the noninvasive optical physiological sensor is worn by the user and during operation of the noninvasive optical physiological sensor, and wherein the plurality of detectors are configured to receive light passed through the outwardly protruding convex surface after attenuation by tissue of the user.

Ex. 1001, 44:36–56 (bracketed identifiers [a]–[d] added). Independent claims 7 and 20 include similar limitations. *Id.* at 45:9–22; 46:12–34.

E. Evidence Relied Upon

Petitioner relies on the following references:

Reference	**Publication/Patent Number**	**Exhibit**
Aizawa	U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002.	1006
Inokawa	Japanese Patent Application Publication No. 2006-296564 A, filed April 18, 2005, published November 2, 2006.	1007, 1008[1]
Ohsaki	U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001.	1014

[1] Exhibit 1008 is an English translation of Exhibit 1007.

Reference	Publication/Patent Number	Exhibit
Mendelson-2006	"A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," Proceedings of the 28th IEEE EMBS Annual International Conference, 912–915 (2006).	1016
Beyer	U.S. Patent No. 7,031,728 B2 issued April 18, 2006.	1019
Goldsmith	U.S. Patent Application Publication No. 2007/0093786 A1, filed July 31, 2006, published April 26, 2007.	1027
Lo	U.S. Patent Application Publication No. 2004/0138568 A1, filed June 15, 2003, published July 15, 2004.	1028
Mendelson-1988	"Design and Evaluation of a New Reflectance Pulse Oximeter Sensor," Worcester Polytechnic Institution, Biomedical Engineering Program, Worcester, MA 01609; Association for the Advancement of Medical Instrumentation, Vol. 22, No. 4, 1988, 167–173.	1015

Pet. 1–2.

Petitioner also relies on the declaration testimony of Thomas W. Kenny, Ph.D. (Exhibits 1003 and 1047). Patent Owner relies on the declaration testimony of Vijay K. Madisetti, Ph.D. (Exhibit 2004).

F. Asserted Grounds

We instituted an *inter partes* review based on the following grounds:

Claim(s) Challenged	35 U.S.C. §	References/Basis
1–15, 17, 20–26, 28	103	Aizawa, Inokawa
1–15, 17, 20–26, 28	103	Aizawa, Inokawa, Ohsaki
18, 19, 29, 30	103	Aizawa, Inokawa, Mendelson-2006, Beyer
18, 19, 29, 30	103	Aizawa, Inokawa, Goldsmith, Lo
1–17, 20–28	103	Mendelson-1988, Inokawa
18, 19, 29, 30	103	Mendelson-1988, Inokawa, Mendelson-2006, Beyer

II. ANALYSIS

A. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103 if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which said subject matter pertains. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of non-obviousness.[2] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also "determine whether there was an apparent reason to combine the

[2] Patent Owner does not present objective evidence of non-obviousness.

known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of prior art elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

B. Level of Ordinary Skill in the Art

Petitioner identifies the appropriate level of skill in the art as that possessed by a person having "a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information." Pet. 3–4 (citing Ex. 1003 ¶¶ 21–22). "Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline." *Id.* at 4.

Patent Owner "applies Petitioner's level of skill." PO Resp. 10; Ex. 2004 ¶¶ 36–39. Patent Owner emphasizes that this level of skill requires no specific education or experience "with optics or optical physiological monitors" or "in physiology," and instead "focuses on data processing and not sensor design." PO Resp. 10; Ex. 2004 ¶ 37.

The level of ordinary skill in the art offered by Petitioner is reasonable based on the record and is agreed to by the parties. We also determine it is consistent with the ’628 patent claims and the prior art of record. We adopt Petitioner’s expressed level of ordinary skill in the art in this Decision.

C. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2019). Although both parties contend that no claim term requires express construction (Pet. 3; PO Resp. 10), we discern from the substance of the parties’ briefing that there is a dispute that emerges for the claim term “cover.”

1. “cover”

Each of independent claims 1, 7, and 20 requires “a light permeable cover.” Ex. 1001, 44:44, 45:18, 46: 22.

Patent Owner argues that the claimed “cover” must be construed to exclude “an optically clear adhesive/epoxy” and a “resin on a surface.” PO Resp. 51–52. According to Patent Owner, “the ’628 Patent distinguishes a resin on a surface from a cover, explaining: ‘the cylindrical housing 1430 (and transparent cover 1432) . . . can protect the detectors 1410c and conductors 1412c ***more effectively*** than currently-available ***resin epoxies***.’” *Id.* at 51 (quoting Ex. 1001, 36:35–45).

Patent Owner alleges that Dr. Kenny also “distinguished a sealing resin from a cover, acknowledging a ‘layer of sealing resin’ is ‘one way to protect the components ***without using a cover***.’” *Id.* at 51–52 (quoting

Ex. 2009, 395:22–396:17). Patent Owner argues that its construction is consistent with how a person of ordinary skill in the art would have understood the term based upon the state of the art at the time of filing. *Id.* at 52 (citing Ex. 1008 ¶ 103, Fig. 17; Ex. 1023 ¶ 35; Ex. 1027 ¶ 85, Fig. 9B; Ex. 2004 ¶ 114).

Petitioner replies that "there is nothing in the specification or the prosecution history [of the '628 patent] that would lead a [person of ordinary skill in the art] to conclude that 'cover' should be interpreted based on anything other than its plain meaning." Pet. Reply 28 (citing *Thorner v. Sony Computer Entertainment America LLC*, 669 F.3d 1362, 1368 (Fed. Cir. 2012)). That plain meaning, according to Petitioner, is that "a cover is merely 'something that protects, shelters, or guards.'" *Id.* (quoting Ex. 1050; citing Pet. 70–73; Ex. 1047 ¶ 56). Petitioner argues that Patent Owner's reliance on the '628 patent Specification takes certain text out of context, and when this context is considered, it is clear that "the epoxy resin to which the '628 patent compares its cover is not [an] epoxy cover . . . but rather epoxy that is applied to solder joints." *Id.* at 28 (citing Ex. 1001, 36:41–45; Ex. 1047 ¶ 58).

Petitioner also contends that Patent Owner "mischaracterizes Dr. Kenny's deposition testimony to say he agreed that 'sealing resin' is somehow distinguished from a cover." Pet. Reply 28. Rather, Petitioner contends that Dr. Kenny simply "clarified that using a sealing resin is 'a pretty common way to protect electronic components.'" *Id.* at 28–29 (citing Ex. 2009, 395:22–396:17; Ex. 1047 ¶ 57). Further according to Petitioner, "such extrinsic evidence would not justify departure from plain meaning under *Thorner*." *Id.* at 29.

Patent Owner maintains in response that the ’628 patent Specification disclosure at issue “specifically ***distinguishes*** a ‘resin’ on a surface from a ‘cover,’” and Petitioner’s reading of this disclosure is not persuasive. Sur-reply 21–24.

Upon review of the foregoing, we disagree with Patent Owner’s limiting construction of the term “cover” to exclude epoxy and resin. The plain and ordinary meaning of the term does not support Patent Owner’s construction. A “cover” ordinarily connotes “something that protects, shelters, or guards.” Ex. 1050 (*Merriam-Webster’s Collegiate Dictionary*, 11th ed. (©2005)), 288. That plain and ordinary meaning is consistent with the ’628 patent’s description of “flex circuit cover 360, which can be made of plastic or another suitable material . . . [and] can cover and thereby protect a flex circuit (not shown).” Ex. 1001, 22:63–23:4. It also is consistent with the ’628 patent’s description and illustration of “transparent cover 1432” in Figure 14D, which covers and protects detectors 1410c and conductors 1412c, and which “can be fabricated from glass or plastic, *among other materials*.” *See id.* at 36:27–45 (emphasis added), Figs. 14D–14E.

This is not the situation in which a special definition for a claim term has been set forth in the specification with reasonable clarity, deliberateness, and precision, so as to give notice of the inventor’s own lexicography. *See Merck & Co. v. Teva Pharms. USA, Inc.*, 395 F.3d 1364, 1370 (Fed. Cir. 2005); *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Nor do we discern that Patent Owner “demonstrate[d] an intent to deviate from the ordinary and accustomed meaning of a claim term by including in the specification expressions of manifest exclusion or restriction, representing a

clear disavowal of claim scope." *Teleflex, Inc. v. Ficosa North America Corp.*, 299 F.3d 1313, 1325 (Fed. Cir. 2002).

Here, based upon our review of the intrinsic evidence, no such special definition or express disavowal of the term "cover" to exclude epoxy and resin exists. Patent Owner relies on the following description of Figure 14D in that regard:

> In certain embodiments, *the cylindrical housing 1430 (and transparent cover 1432)* forms an airtight or substantially airtight or hermetic seal with the submount 1400c. As a result, the cylindrical housing 1430 can protect the detectors 1410c and conductors 1412c from fluids and vapors that can cause corrosion. Advantageously, *in certain embodiments, the cylindrical housing 1430 can protect* the detectors 1410c and conductors 1412c *more effectively than currently-available resin epoxies*, which are sometimes applied to solder joints between conductors and detectors.

Ex. 1001, 36:36–45 (emphases added). First, the sentence cited by Patent Owner begins with the phrase "in certain embodiments," which indicates the claimed invention is open to other embodiments, so there is no lexicography or disavowal here. Second, we agree with Petitioner's reading of this sentence as distinguishing the prior art from the claimed invention based on the *location* of the material (being applied only to solder joints between conductors and detectors in the prior art, as opposed to covering the conductors and detectors in the invention) and not the *type* of material. Third, at best, the '628 patent expresses a preference for a cover to be made of glass or plastic, because such materials provide "more effective[]" protection than resin epoxies that were known to the inventors of the '628 patent when it was filed. *See id.* at 36:41–45. But even this reading recognizes that resin epoxies provide some amount of protection, albeit

perhaps a lesser amount than glass or plastic, and is not excluded from forming the material of a cover.

Dr. Kenny's deposition testimony cited by Patent Owner also does not persuade us that, in the context of the '628 patent, an epoxy or resin is excluded from the material of a cover. Dr. Kenny testifies that "a layer of sealing resin" "[c]ould" be used to protect the electronic components in a sensor (Ex. 2009, 395:22–396:8). He was then asked "So that would be one way to protect the components without using a cover, correct?" to which he answered "[t]here are many ways to protect the elements other than using a cover" and maintained his proposed combination of prior art has a "cover" to achieve purposes other than protecting electronic components. *Id.* at 396:9–17. He did not squarely testify that sealing resin could never be a cover.

Accordingly, in the context of the '628 patent, we do not construe the claimed "cover" to exclude epoxy and resin.

2. Other Claim Terms

Upon consideration of the entirety of the arguments and evidence presented, we conclude no further explicit construction of any claim term is needed to resolve the issues presented by the arguments and evidence of record. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (per curiam) (claim terms need to be construed "only to the extent necessary to resolve the controversy" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Obviousness over Aizawa and Inokawa

Petitioner contends that claims 1–15, 17, 20–26, and 28 of the '628 patent would have been obvious over the combined teachings of Aizawa and Inokawa. Pet. 6–43.

1. Overview of Aizawa (Ex. 1006)

Aizawa is a U.S. patent application publication titled "Pulse Wave Sensor and Pulse Rate Detector," and discloses a pulse wave sensor worn on a user's wrist that detects light output from a light emitting diode and reflected from a patient's artery. Ex. 1006, codes (54), (57).

Figure 1(a) of Aizawa is reproduced below.

FIG. 1 (a)

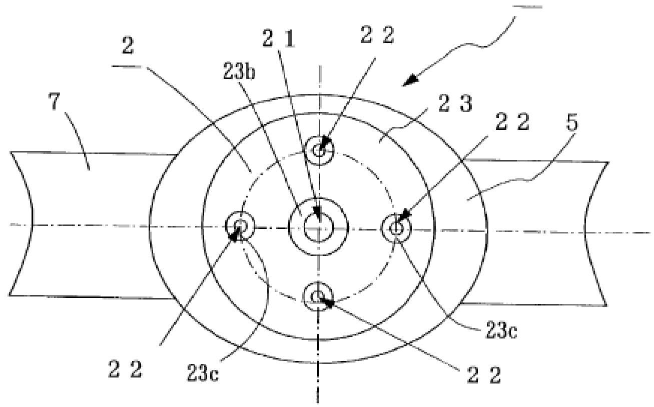


Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode ("LED") 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses that, "to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased." *Id.* ¶ 32, Fig. 4(a). "The same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector 22." *Id.* ¶ 33.

Figure 1(b) of Aizawa is reproduced below.

FIG. 1 (b)

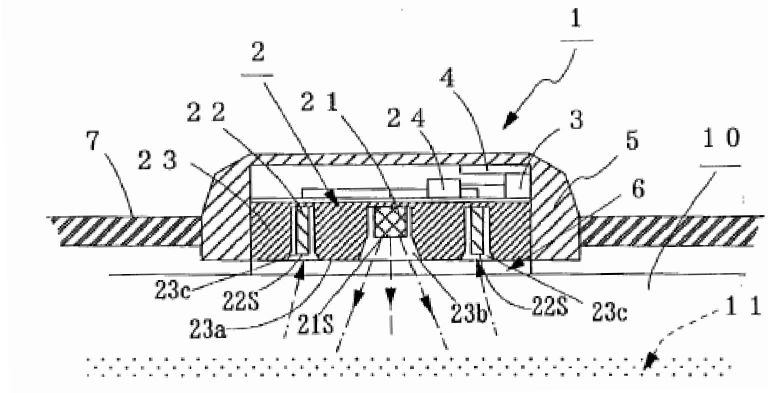


Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an "unshown display." *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.*

Aizawa discloses that LED 21 and photodetectors 22 "are stored in cavities 23b and 23c formed in the detection face 23a" of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a "is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a." *Id.* Aizawa discloses that "a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting face 21s of the light emitting diode 21 faces down (on the wrist 10 side)." *Id.* ¶ 26. Acrylic transparent plate 6 is disposed between holder 23 and the

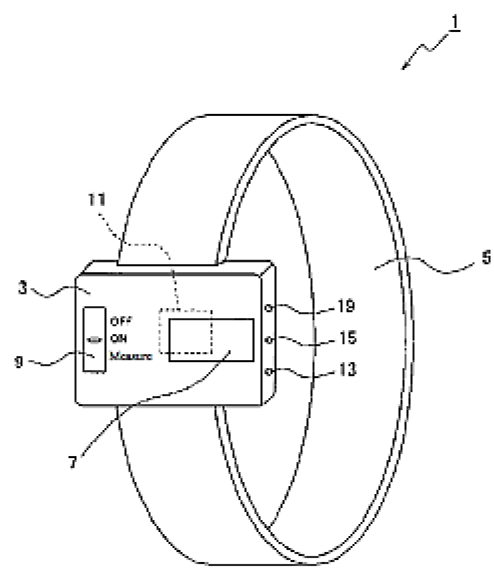
user's wrist 10. *Id.* ¶¶ 23, 26, 30. Furthermore, "belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10. "Since the acrylic transparent plate 6 is provided on the detection face 23a of the holder 23, adhesion between the pulse rate detector 1 and the wrist 10 can be improved, thereby further improving the detection efficiency of a pulse wave." *Id.* ¶ 30.

2. *Overview of Inokawa (Ex. 1008)*

Inokawa is a Japanese published patent application titled "Optical Vital Sensor, Base Device, Vital Sign Information Gathering System, and Sensor Communication Method," and discloses a pulse sensor device that may be worn on a user's wrist. Ex. 1008, code (54), ¶ 56.[3]

Figure 1 of Inokawa is reproduced below.

(FIG. 1)



[3] Exhibit 1008 is an English translation of Exhibit 1007. In this Decision, all citations are to the English translation.

Figure 1 illustrates a perspective view of a pulse sensor. *Id.* ¶ 56. Pulse sensor 1 includes box-shaped sensor unit 3 and flexible annular wristband 5. *Id.* ¶ 57. Sensor unit 3 includes a top surface with display 7 and control switch 9, and a rear surface (sensor-side) with optical device component 11 for optically sensing a user's pulse. *Id.*

Figure 2 of Inokawa is reproduced below.

(FIG. 2)

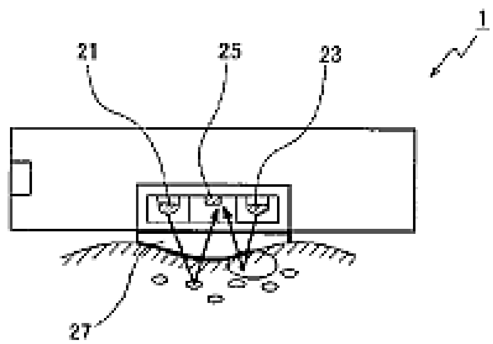


Figure 2 illustrates a schematic view of the rear surface of the pulse sensor. *Id.* ¶ 58. The rear-side (sensor-side) of pulse sensor 1 includes a pair of light-emitting elements, i.e., green LED[4] 21 and infrared LED 23, as well as photodiode 25 and lens 27. *Id.* In various embodiments, Inokawa discloses that the sensor-side lens is convex. *See id.* ¶¶ 99, 107. Green LED 21 senses "the pulse from the light reflected off of the body (i.e.[,] change in the amount of hemoglobin in the capillary artery)," and infrared LED 23 senses body motion from the change in reflected light. *Id.* ¶ 59. The pulse sensor stores this information in memory. *Id.* ¶ 68. To read and store information, the pulse sensor includes a CPU that "performs the processing to sense pulse, body motion, etc. from the signal . . . and temporarily stores the analysis data in the memory." *Id.* ¶ 69.

[4] We understand "LED" to be an acronym for "light emitting diode."

Pulse sensor 1 includes lens 27, which "makes it possible to increase the light-gathering ability of the LED as well as to protect the LED or PD[5]." *Id.* ¶¶ 15, 58. Pulse sensor 1 also uses LEDs 21 and 23 to download data to a base station, as shown in Figure 3, reproduced below.

(FIG. 3)

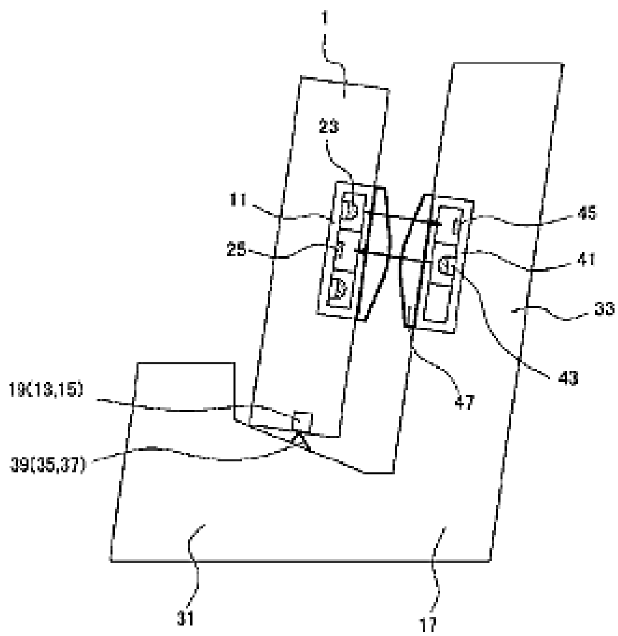


Figure 3 illustrates a pulse sensor mounted on base station 17. *Id.* ¶¶ 60, 66. Pulse sensor 1 is depicted as mounted to base device 17, which "is a charger with communication functionality." *Id.* ¶ 60. When so mounted, sensor optical device component 11 and base optical device component 41 face each other in close proximity. *Id.* ¶ 66. In this position, pulse sensor 1 can output information to the base device through the coupled optical device components. *Id.* ¶ 67. Specifically, the pulse sensor CPU performs the controls necessary to transmit pulse information using infrared LED 23 to photodetector 45 of base device 17. *Id.* ¶¶ 67, 70, 76.

[5] We understand "PD" to be an acronym for "photodiode."

In an alternative embodiment, additional sensor LEDs and base photodetectors can be used to efficiently transmit data and improve accuracy. *Id.* ¶ 111.

3. Claim 1

i. "A noninvasive optical physiological sensor comprising"

The record supports Petitioner's undisputed contention that Aizawa discloses a noninvasive optical sensor.[6] Pet. 23; *see, e.g.*, Ex. 1006 ¶ 2 (disclosing "pulse wave sensor for detecting the pulse wave of a subject from light reflected from a red corpuscle in the artery of a wrist of the subject by irradiating the artery of the wrist").

ii. [1a] "a plurality of emitters configured to emit light into tissue of a user;"

[1b] "a plurality of detectors configured to detect light that has been attenuated by tissue of the user, wherein the plurality of detectors comprises at least four detectors;"

(1) Petitioner's Undisputed Contentions

Petitioner contends that Aizawa discloses an emitter—LED 21—and also states that, in certain embodiments, multiple LEDs may be employed. Pet. 7, 18. Patent Owner does not dispute this contention, and we agree with Petitioner. *See* Ex. 1006 ¶¶ 23 ("LED 21"), 32 ("The arrangement of the light emitting diode 21 and the photodetectors 22 is not limited to this."). For example, Aizawa explains that "[t]he same effect can be obtained when

[6] Whether the preamble is limiting need not be resolved, because Petitioner shows sufficiently that the recitation in the preamble is satisfied by the prior art.

the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector." *Id.* ¶ 33.

Petitioner also contends that Inokawa teaches a sensor with two LEDs–a green LED to sense pulse and an infrared LED to sense body motion. Pet. 10–11, 18. Petitioner further contends that when Inokawa's sensor is mounted on a base device, the infrared LED also is used to wirelessly transmit vital information to the base device. *Id.* at 21. Patent Owner does not dispute these contentions, and we agree with them. Inokawa teaches a pair of LEDs 21, 23, where "the basic function of the S-side green LED 21 is to sense the pulse from the light reflected off of the body . . . , while the S-side infrared LED 23 serves to sense body motion from the change in this reflected light." Ex. 1008 ¶¶ 58–59. Inokawa also explains that "vital sign information stored in the memory 63 [of the sensor], such as pulse and body motion, is transmitted to the base device 17 using the S-side infrared LED 23 of the pulse sensor 1 and the B-side PD 45 of the base device 17," such that "there is no need to use a special wireless communication circuit or a communication cable." *Id.* ¶¶ 76–77.

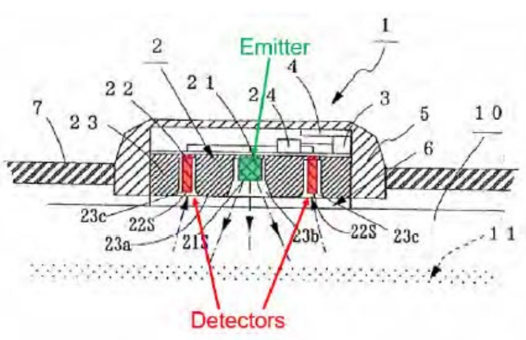
The record further supports Petitioner's undisputed contentions as to the disclosure of multiple photodetectors in Aizawa. *See* Pet. 25–26. Petitioner relies on Aizawa's disclosure of "***four photodetectors 22***" that operate to "detect light 'reflected by a red corpuscle running through the artery 11 of the wrist 10 . . . so as to detect a pulse wave.'" *Id.* (citing Ex. 1006 ¶¶ 24, 27, 29, 32, Fig. 1(a)).

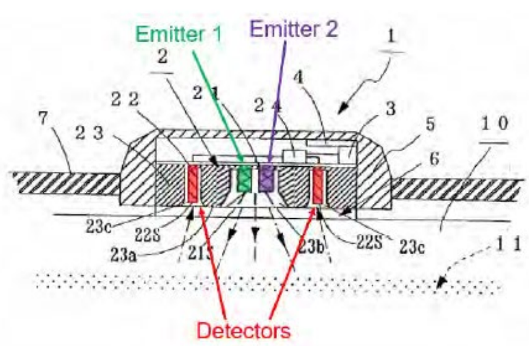
(2) Petitioner's Disputed Contentions

Petitioner points to Aizawa's disclosure of "a centrally located LED/emitter," but notes that "Aizawa never specifically identifies the use of

multiple emitters operating at different wavelengths in conjunction with multiple detectors." Pet. 18 (citing Ex. 1006 ¶¶ 23, 33). Petitioner, however, relies on Inokawa as disclosing "two different types of emitters 'such as an infrared LED or a green LED' and that 'work can be divided between the various means, with an infrared LED used to detect vital signs and transmit vital sign information, and a green LED used to detect pulse.'" *Id.* (citing Ex. 1008 ¶¶ 14, 44, 58, 59). Petitioner reasons that a person of ordinary skill in the art "would have found it obvious to incorporate the two LEDs of Inokawa into Aizawa." *Id.* at 24. Petitioner also explains that "[i]t would have been obvious to split the single LED/emitter of Aizawa into two LEDs/emitters having different wavelengths to (i) acquire body motion information for improved pulse detection and/or (ii) more reliably transmit information from the sensor to a base device with less error." *Id.* at 25 (citing Ex. 1008 ¶¶ 7, 14, 44, 48, 58, 59, 60, 62, 77). Furthermore, Petitioner expresses the following:

> The added ability to measure body movement can allow for a more reliable pulse measurement that takes into account and corrects for inaccurate readings stemming from body movement. Thus, a [person of ordinary skill in the art] would have been motivated and found it obvious to divide the single emitter of Aizawa, as shown below into two emitters operating at two difference wavelengths.





Id. at 19 (citing Ex. 1003 ¶¶ 75, 76).

Petitioner additionally contends that applying an additional emitter to Aizawa's device "merely entails the use of known solutions to improve similar systems and methods in the same way" and that Inokawa's teachings of multiple emitters "would have led to predictable results without significantly altering or hindering the functions performed by Aizawa's sensor." *Id.* at 20 (citing *KSR*, 550 U.S. at 417; Ex. 1003 ¶¶ 77–78).

As an additional and independent motivation for incorporating a second emitter in Aizawa, Petitioner contends that, although Aizawa "contemplates uploading data to a base device," it "is silent about how such transmission would be implemented." *Id.* at 20–21. According to Petitioner, however, a skilled artisan would have "recognized that incorporating Inokawa's base device and LED-based data transmissions would allow Aizawa to upload data from its sensor in a way that is wireless (thus avoiding the problems of a physical cable) and that does not require a separate RF circuit." *Id.* at 22 (citing Ex. 1003 ¶ 81). According to Dr. Kenny, one of ordinary skill in the art would have "incorporate[d] Inokawa's base device and LED-based data transmission into Aizawa's sensor to, for instance, 'make[] it possible to transmit vital sign information to the base device 17 accurately, easily, and without malfunction'" and "without having to incorporate a separate RF circuit into Aizawa's wrist sensor." Ex. 1003 ¶ 81 (citing Ex. 1008 ¶ 7). Petitioner further reasons that Inokawa's data transmission disclosure that incorporates two emitters or LEDs provides for increased accuracy of data transmission. *Id.* at 21–22 (citing Ex. 1003 ¶¶ 82, 83).

(3) Patent Owner's Contentions

Patent Owner disputes Petitioner's contentions regarding the obviousness of modifying Aizawa to include two emitters. *See, e.g.*, PO Resp. 35–41; Sur-reply 14–17. According to Patent Owner, "[n]either Aizawa nor Inokawa discloses both a plurality of emitters and at least four detectors." PO Resp. 35 (citing Ex. 2004 ¶ 79). Patent Owner, thus, is of the view that the teachings of the noted references would not have suggested associating multiple emitters with the multiple detectors of Aizawa's sensing device.

In particular, Patent Owner first argues that neither Aizawa nor Inokawa discloses a device with both multiple detectors *and* multiple emitters in the *same* sensor, because Aizawa's embodiments have either a single emitter and multiple detectors (e.g., Ex. 1006, Fig. 1(a)) or multiple emitters and a single detector (e.g., *id.* ¶ 33), and Inokawa discloses multiple emitters and a single detector (e.g., Ex. 1008, Fig. 2). *See* PO Resp. 35–36 (citing, e.g., Ex. 1006 ¶ 33, Figs. 1, 2, 4, 5; Ex. 1008 ¶ 58, Fig. 2; Ex. 2004 ¶¶ 79–80). Patent Owner concludes, therefore, that there would have been no reason for a person of ordinary skill in the art to have added a second emitter to Aizawa, when Aizawa already discloses an embodiment with multiple LEDs, i.e., an embodiment with only a single detector. *Id.* at 36–37 (citing, e.g., Ex. 2004 ¶ 81–83).

Patent Owner also argues that the evidence does not support either of Petitioner's two proffered motivations for modifying Aizawa to include two emitters. As to the first motivation (to measure body movement using a second emitter), Patent Owner asserts that Dr. Kenny erroneously testifies that Aizawa cannot perform such measurement with its single emitter. *Id.*

at 37 (citing, e.g., Ex. 1006 ¶ 15; Ex. 2007, 400:7–401:10; Ex. 2004 ¶ 84). Patent Owner argues that "Dr. Kenny incorrectly believed that Aizawa's sensor attempts to prevent motion rather than account for it" but that "Aizawa expressly states that it provides a 'device for ***computing*** the ***amount*** of motion load from the pulse rate.'" *Id.* (citing Ex. 1006 ¶ 15; Ex. 2004 ¶ 84).

As to Petitioner's second motivation (to enable transmission of data to a base device using an optical communication link), Patent Owner argues that "Aizawa ***already*** includes a wireless transmitter . . . so Aizawa does not need to incorporate Inokawa's base-device [optical] data transmission arrangement." PO Resp. 38 (citing, e.g., Ex. 1006 ¶¶ 23, 28, 35; Ex. 2004 ¶¶ 85–86). Indeed, Patent Owner argues that "Dr. Kenny acknowledged Aizawa does not indicate there are any problems with Aizawa's form of data transmission." *Id.* (citing Ex. 2007, 409:13–410:2). Patent Owner further argues that "Aizawa's goal is 'real-time measuring' with the transmitter 'transmitting the measured pulse rate data to a display'" but that "Inokawa's base device, however, only transmits pulse rate data 'when the pulse sensor . . . is mounted onto the base device.'" *Id.* at 38–39 (citing, *e.g.*, Ex. 1008, Abstract). Patent Owner also contends that "[r]eplacing Aizawa's wireless transmission with a base-device-transmitter eliminates the ability to take and display real-time measurements, one of Aizawa's stated goals, while increasing power consumption and cost." *Id.* at 39 (citing Ex. 2009, 381:18–382:8, 383:22–385:9, 390:5–392:3; Ex. 2004 ¶ 86). Patent Owner insists that Inokawa does not aid Petitioner's case, because Inokawa discloses the benefits of using a second emitter in only two situations, i.e., first, to improve over a "mechanically-connected system," e.g., with a cable for

communication, and, second, to avoid use of a "dedicated wireless communication circuit," whereas "Aizawa ***already*** uses wireless transmission to provide real-time measurements." *Id.* at 39–40 (citing, e.g., Ex. 1008 ¶ 4; Ex. 2004 ¶ 87).

Patent Owner further contends that Petitioner and Dr. Kenny overlooked further complications that would ensue from modifying Aizawa to have two emitters. Patent Owner argues that Dr. Kenny did not address issues of thermal interference with sensor performance in adding a second LED to a physiological sensor, which would require "structural changes." PO Resp. 40–41 (citing, e.g., Ex. 1003 ¶ 76; Ex. 2004 ¶ 88; Ex. 2012, 59–60; Ex. 2007, 379:17–21, 384:16–388:16, 389:17–390:20). Patent Owner also argues that Dr. Kenny "acknowledged that changing the size of the emitter cavity could affect the optical performance of the device," but that necessary "redesign" requirements are absent from his testimony and the Petition. *Id.* at 56–57 (citing, e.g., Ex. 2007, 394:11–395:17).

(4) Petitioner's Reply

As to Petitioner's first motivation, Petitioner contends that adding an additional LED enables the sensor to distinguish between blood flow and body movement, which provides a "more reliable" pulse measurement, and constitutes Petitioner's proposed improvement to Aizawa. Pet. Reply 22 (citing, e.g., Ex. 1003 ¶¶ 76; Ex. 2007, 401:11–402:4; Ex. 1047 ¶ 46). Moreover, Petitioner expresses that by using multiple LEDs at different wavelengths, "two separate signals" can be collected, which "allows noise arising from body motion to be better isolated and accounted for." *Id.* at 22–23 (citing Ex. 1047 ¶ 46–47).

As to Petitioner's second motivation, Petitioner maintains that Inokawa's use of two emitters having different wavelengths to upload data to a base device using optical communication advantageously improves the accuracy of the transmission by providing "checksum" information. *Id.* at 23 (citing, e.g., Ex. 1003 ¶ 82; Ex. 1008 ¶¶ 44, 48, 111; Ex. 2007, 407:7–408:20, 416:5–15; Ex. 1047 ¶ 48).

In connection with the "other complications" that Patent Owner alleges would result from the proposed modification, Petitioner urges that "such minor issues are 'part of what [a person of ordinary skill in the art] would bring . . . to the problem and would know how to make the changes needed.'" *Id.* at 24 (quoting Ex. 2007, 384:8–388:12; Ex. 1047 ¶ 49).

(5) Patent Owner's Sur-reply

With respect Petitioner's first proposed motivation, Patent Owner argues that Inokawa's disclosure is as sparse as Aizawa's disclosure regarding how to use optical data to measure body movement. Sur-reply 15 (citing Ex. 1008 ¶ 59). Patent Owner also asserts that "Petitioner cites nothing in Inokawa that suggests" that Inokawa's two emitter data gathering is more reliable or otherwise superior to Aizawa's single emitter data gathering. *Id.*

Concerning Petitioner's second motivation, Patent Owner argues that the proposed modification eliminates Aizawa's ability to conduct "***real-time*** collection and display of physiological measurements—a key goal of Aizawa's system." *Id.* at 15–16.

Patent Owner also notes that Petitioner does not dispute that the proposed modification would cause problems such as "additional cost,

energy use, and thermal problems" that would ensue from using two emitters in the Aizawa device. *Id.* at 17.

(6) Discussion

Upon review of the foregoing, we conclude that a preponderance of the evidence supports Petitioner's views that it, in light of Inokawa's teachings, it would have been obvious to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED.

First, a person of ordinary skill in the art would have had reason to make this replacement to improve the pulse measurements recorded by Aizawa's detector 1. Inokawa teaches that the infrared LED's signal can be used "to detect vital signs" such as "body motion," and the green LED's signal can be "used to detect pulse." Ex. 1008, Fig. 2, ¶¶ 14, 58–59; Ex. 1003 ¶¶ 68, 80, 83–85; Ex. 1047 ¶¶ 46–47.

Patent Owner correctly points out that Aizawa describes its single-emitter detector 1 as transmitting pulse data to "a device for computing the amount of motion load from the pulse rate." Ex. 1006 ¶¶ 15, 28, 35. But, this description is the only disclosure in Aizawa cited by Patent Owner as relating to computing a motion characteristic of the user. Further, we are unable to discern any other disclosure in Aizawa relating to motion computation, or what Aizawa proposes to do with its motion computation. *See id.* Based on the sparse nature of Aizawa's disclosure concerning motion load, it is not clear precisely what Aizawa proposes to do with the computed motion load, after it is computed. *See, e.g.*, Ex. 1047 ¶ 46 ("Aizawa does not even say whether it uses the computed motion load to improve the detection signal."). Aizawa, however, does describe the motion

load as being computed "from the pulse rate," rather than being an input to the pulse rate calculation. Ex. 1006 ¶¶ 15, 35.

In a deposition for other proceedings related to this *inter partes* review (*see supra* § I.B), Dr. Kenny was asked whether it was his understanding that "Aizawa's sensor could not account for motion load?"; Dr. Kenny answered that "Aizawa's sensor attempts to prevent motion load rather than account for it." Ex. 2007, 400:7–11 (deposition for IPR2020-01520, IPR2020-01537, and IPR2020-01539). He explained that, because Aizawa uses only a single emitter with a single wavelength, "what [Aizawa] sees as a signal would be some mixture of pulse rate and motion load if there was no effort to prevent motion load," so Aizawa seeks to solve the problem of "prevent[ing] motion load from corrupting the pulse rate signal." *Id.* at 400:12–401:10. Dr. Kenny did not further explain this distinction between preventing and accounting for motion load in his deposition testimony cited by the parties as relating to this issue. *Id.* at 400:7–402:4. We do not rely on this distinction as a basis for our present decision, because we find no express support for it in Aizawa's disclosure (*see* Ex. 1006 ¶¶ 15, 28, 35), and it is not explained in persuasive detail by Dr. Kenny.

We nonetheless credit Dr. Kenny's declaration testimony that a person of ordinary skill in the art, upon reviewing Inokawa's disclosure of using two emitters of different wavelengths to calculate a user's pulse and motion separately, would understand that these two separate measurements would enable the device to calculate a "more reliable" pulse rate because it "allows noise arising from body motion to be better isolated and accounted for." Ex. 1047 ¶ 47; *see* Ex. 1003 ¶¶ 76–78. Aizawa does not disclose using the computed motion load in this fashion, so it appears that this would improve

upon the accuracy of Aizawa's pulse measurements, by using the computed motion load to isolate and account for noise. *See* Ex. 1006 ¶¶ 15, 28, 35.

Dr. Madisetti also offers no meaningful opposing testimony in this regard. *See, e.g.*, Ex. 2004 ¶ 84. Instead, Dr. Madisetti incorrectly reads Dr. Kenny's motivation testimony as being limited to the desirability of adding the bare ability to measure body movement to Aizawa. *See id.* Yet, Dr. Kenny further testified that it would have been beneficial to *use* the measured body movement to *improve* the pulse measurement of the device. *See* Ex. 1003 ¶¶ 76–78; Ex. 1047 ¶ 47. Dr. Madisetti does not address that testimony. *See* Ex. 2004 ¶ 84.

Thus, because Dr. Madisetti's testimony does not directly address the entirety of Dr. Kenny's testimony in this regard, Dr. Kenny's testimony stands unrebutted on this point in the record before us. Dr. Kenny's testimony also makes intuitive sense. Measuring the user's motion *separately* from the user's pulse, for example by using two interrogating emitters of two different wavelengths, would provide a reliable means of correcting the pulse data for motion artifacts by using the separately measured motion data, rather than by trying to segregate these two components in the single data stream provided by Aizawa's single emitter device. *See, e.g.*, Ex. 1047 ¶ 47. We, therefore, are persuaded by Dr. Kenny's unrebutted testimony that using two emitters of different wavelengths would improve Aizawa's device in this way.

Independently, we are also persuaded that a person of ordinary skill in the art would have been motivated to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, to provide a reliable method of uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1

to another device for display to the user. Inokawa expressly touts such optically-based uploading of data from Inokawa's wrist-worn sensor 1 to Inokawa's base device 17 as a benefit of incorporating two emitters in sensor 1. *See* Ex. 1008, Figs. 3, 19, ¶¶ 3–7, 14, 76–77, 109–111. Inokawa identifies two specific benefits of this optically-based data communication means. First, the infrared LED can transmit the pulse data, and the green LED can separately transmit "checksum" information to increase the accuracy of data transmission. *Id.* at Fig. 19, ¶¶ 14, 109–111. Second, using light emitters in this fashion to perform two functions (data collection by emitting light into the user's wrist, and data transmission by emitting light to photodetectors in a base device) obviates the need for providing "a special wireless communication circuit [in the wrist-worn sensor 1] or a communication cable." *Id.* ¶¶ 3–7, 76–77.

Patent Owner correctly points out that Aizawa already has "transmitter" 4 for uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for processing and for display to the user. Ex. 1006, Fig. 1(b), ¶¶ 15, 23, 28, 35. Nevertheless, Aizawa's Figure 1(b) illustrates transmitter 4 only as an empty box contained within outer casing 5, and Aizawa's written description does not provide further structural details concerning transmitter 4. *See id.* In particular, Aizawa does not describe exactly how transmitter 4 transmits its data to the other device. *See id.*

Patent Owner contends, and Dr. Madisetti and Dr. Kenny both testify, that Aizawa's transmitter 4 is a "wireless" transmitter. *See, e.g.*, PO Resp. 38; Ex. 2004 ¶¶ 85–87; Ex. 2007, 403:17–22, 414:19–21. They all appear to equate "wireless" communication to radio frequency

communication, and not to include optical communication, even though both radio frequency and optical communication do not use a wire. Based on the foregoing testimony, we assume, for this decision, that Aizawa contemplates radio frequency communication as one embodiment by which transmitter 4 may transmit data to devices other than detector 1.

Patent Owner argues, and Dr. Madisetti testifies, that Aizawa's express disclosure goes even further. They assert that Aizawa's "goal" is to measure and display pulse data *in real time during exercise*, using the wireless transmitter. *See, e.g.*, Ex. 2004 ¶¶ 86–87. We find that Aizawa does not support this assertion. Instead, Aizawa discusses prior art devices that "estimat[e] a burden on the heart of a person who takes exercise by *real-time measuring* his/her heart rate at the time of exercise" (Ex. 1006 ¶ 4 (emphasis added)), and then describes Aizawa's detector 1 as having a transmitter for transmitting the measured pulse rate data to another device for display (*id.* ¶ 15). Aizawa does not indicate when this transmission occurs. Aizawa also refers to "noise caused by the shaking of the body of the subject" as a problem to be addressed (*id.* ¶ 6), but this problem occurs regardless of whether the shaking results from exercise or the normal movement of the user's wrist over the course of the day. Thus, Aizawa does not tout, as an important feature of Aizawa's invention, the *real time display* of pulse rate data during exercise, regardless of whether the data gathered by Aizawa's wrist-worn detector 1 is transmitted wirelessly or otherwise. *Id.* ¶¶ 4, 6, 15.

No doubt, a person of ordinary skill in the art would have viewed the capability of a wrist-worn pulse detector to transmit its pulse data to another device for display in real time while the user is exercising to be a desirable

feature in some cases, even if this is not one of Aizawa's specifically stated goals. *See, e.g.*, Ex. 1003 ¶ 68 (Dr. Kenny stating: "By wirelessly transmitting the collected data wirelessly, Mendelson-2006's system provides 'numerous advantages," including the ability to determine the condition of a subject 'remotely'"); Ex. 2009, 393:6–14 (in a deposition for other related proceedings, Dr. Kenny agreeing that a person of ordinary skill in the art "would have seen the ability to wirelessly transmit collected data as an advantage"). Nonetheless, Inokawa expressly discloses that, in other cases, the benefits achieved by wireless transmission can be outweighed by obviating the need for the wrist-worn sensor to include a special wireless communication circuit. *See* Ex. 1008 ¶¶ 3–7 (discussing problems associated with wireless transmission, such as the need for a dedicated circuit, which is avoided by Inokawa's system that risks "few malfunctions" and has a "simple structure"), 76–77 ("As a result, there is no need to use a special wireless communication circuit . . . , which makes it possible to transmit vital sign information to the base device 17 accurately, easily, and without malfunction."). We therefore conclude that Petitioner's case for obviousness in this regard is supported by a preponderance of the evidence. *See, e.g.*, *In re Urbanski*, 809 F.3d 1237, 1243–44 (Fed. Cir. 2016) (persons of ordinary skill in the art may be motivated to pursue desirable properties of one prior art reference, even at the expense of foregoing a benefit taught by another prior art reference).

We disagree with Patent Owner's argument that Petitioner's case for obviousness is deficient on the basis that neither Aizawa nor Inokawa expressly discloses a wrist-worn sensor device that has *both* a plurality of emitters *and* at least four detectors, as claim 1 recites. Obviousness does not

require "'some motivation or suggestion to combine the prior art teachings' [to] be found in the prior art." *KSR*, 550 U.S. at 407, 415–418. Nor does it require the bodily incorporation of Inokawa's device into Aizawa's device. *See, e.g.*, *In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (test for obviousness is not whether the features of one reference may be bodily incorporated into the structure of the other reference, but rather is "what the combined teachings of the references would have suggested to those of ordinary skill in the art"); *see also In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) (nonobviousness is not established by attacking references individually when unpatentability is predicated upon a combination of prior art disclosures). Instead, "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton," and "in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle." *KSR*, 550 U.S. at 420–421.

In this case, we are persuaded that a person of ordinary skill in the art would have been motivated to modify Aizawa's wrist-worn detector 1 to replace its single near infrared LED 21 with an infrared LED and a green LED, based on Inokawa, for all the reasons provided above. A person of ordinary skill in the art would additionally have known to keep all four detectors 22 that are already present in Aizawa's detector 1, so that "[e]ven when the attachment position of the sensor is dislocated, a pulse wave can be detected accurately," as disclosed by Aizawa. Ex. 1006 ¶¶ 9, 27. In short, the combination of Aizawa and Inokawa teaches that having multiple emitters is beneficial, and having multiple detectors is beneficial, for different and not inconsistent reasons.

Finally, we agree with Petitioner's position that any thermal interference and power consumption issues that may arise in Aizawa's wrist-worn pulse detector, by using two emitters instead of one emitter, are well within the capabilities of a person of ordinary skill in the art to solve. We credit Dr. Kenny's testimony in this regard. *See, e.g.*, Ex. 1003 ¶¶ 77–78; Ex. 1047 ¶ 49. Indeed, Dr. Kenny recognizes that Aizawa already discloses adding additional emitters. Ex. 1003 ¶ 77 (citing Ex. 1006 ¶ 32). Dr. Kenny further testifies that this modification "amount[s] to nothing more than the use of a known technique [i.e., Inokawa's use of two emitters in a wrist-worn pulse detector] to improve similar devices [i.e., Aizawa's wrist-worn pulse detector] in the same way, and combining prior art elements according to known methods to yield predictable results." *Id.* ¶ 78.

Patent Owner cites portions of Dr. Kenny's deposition testimony that, in Patent Owner's view, indicate Dr. Kenny fails to appreciate the significance of optical interference complications posed by adding a second emitter to Aizawa's device, and fails to explain how this would have been overcome. *See* PO Resp. 40–41 (citing Ex. 2007, 394:11–395:17). We have reviewed this deposition testimony, and we conclude that Patent Owner overstates its significance. It establishes, at most, that Dr. Kenny did not expressly address this issue in his declaration (Exhibit 1003), but Dr. Kenny's opinion is that this would have been within the capability of a person of ordinary skill in the art to resolve. Based on the evidentiary record presented to us, we agree with Dr. Kenny. For example, Inokawa discloses a wrist-worn pulse sensor 1 having two emitters 21 and 23 in close proximity to each other. *See* Ex. 1008, Figs. 1–2. An artisan must be presumed to know something about the art apart from what the relied-upon references

disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962). Consistent with Dr. Kenny's testimony, it follows readily from the teachings of the prior art that an ordinarily skilled artisan would have reasonably understood how to implement two emitters as a part of Aizawa's sensor device, including addressing routine design considerations as a part of such implementation. *See, e.g.*, Ex. 1003 ¶¶ 77–78; Ex. 1047 ¶¶ 48–49.

Dr. Madisetti's testimony opposing Dr. Kenny's foregoing opinion is premised solely on Dr. Kenny's alleged failure to explain how issues that arise from adding a second emitter to Aizawa would have been solved. Dr. Madisetti does not provide any affirmative reason why these issues would have been difficult for a person of ordinary skill in the art to solve, in the context of Aizawa's device or wrist-worn pulse sensing devices in general. *See, e.g.*, Ex. 2004 ¶ 88.

On the record at hand, we conclude that a person of ordinary skill in the art would have had adequate reason to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, and would have had a reasonable expectation of success in doing so.

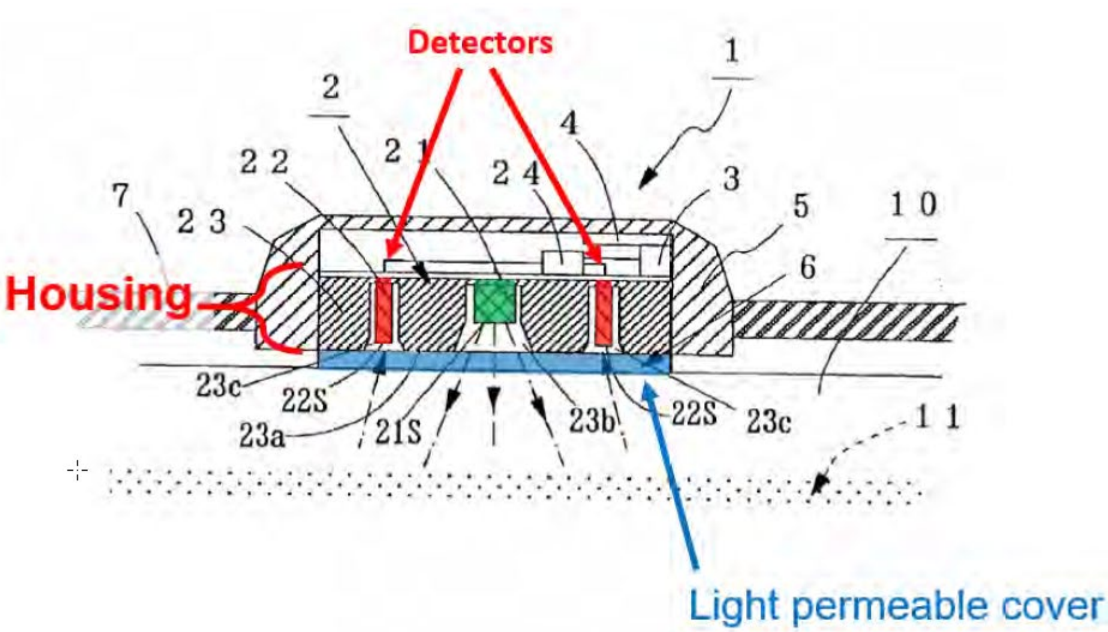
iii. "[1c] a housing configured to house at least the plurality of detectors, and"

The record supports Petitioner's undisputed contentions as to the disclosure of the above-noted housing feature in Aizawa. *See* Pet. 26. Petitioner points to Aizawa's disclosure of "a holder 23 for storing the above light emitting diode 21 and the photodetectors 22." *Id.* (quoting Ex. 1006 ¶¶ 23, 24). We are satisfied that Petitioner sufficiently accounts for the housing feature of claim 1.

iv. *"[1d] a light permeable cover configured to be located between tissue of the user and the plurality of detectors when the noninvasive optical physiological sensor is worn by the user, wherein the cover comprises an outwardly protruding convex surface configured to cause tissue of the user to conform to at least a portion of the outwardly protruding convex surface when the noninvasive optical physiological sensor is worn by the user and during operation of the noninvasive optical physiological sensor, and wherein the plurality of detectors are configured to receive light passed through the outwardly protruding convex surface after attenuation by tissue of the user."*

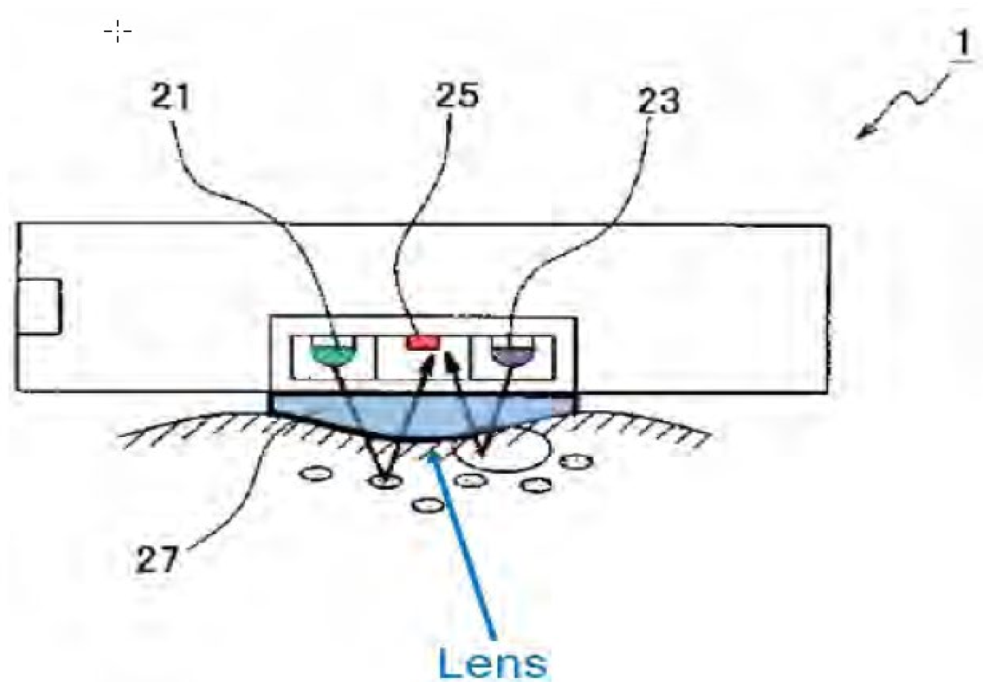
(1) Petitioner's Contentions

The record supports Petitioner's undisputed contentions as to the above-noted feature. *See* Pet. 14–17, 27–30. With reference to an annotated version of Aizawa's Figure 1(b) (reproduced below), Petitioner contends that "Aizawa teaches a light permeable cover in the form of an acrylic transparent plate 6 (blue) that is mounted at the detection face 23a over at least a portion of the housing to cover the at least four detectors (red)." *Id.* at 27.



The figure above shows Petitioner's annotated and colorized version of Aizawa's Figure 1(b). Petitioner contends that beyond disclosure that the light permeable cover is an "acrylic transparent plate that helps to improve 'detection efficiency,' Aizawa does not provide much other detail, for instance regarding its shape." *Id.* at 14 (citing Ex. 1006 ¶ 30).

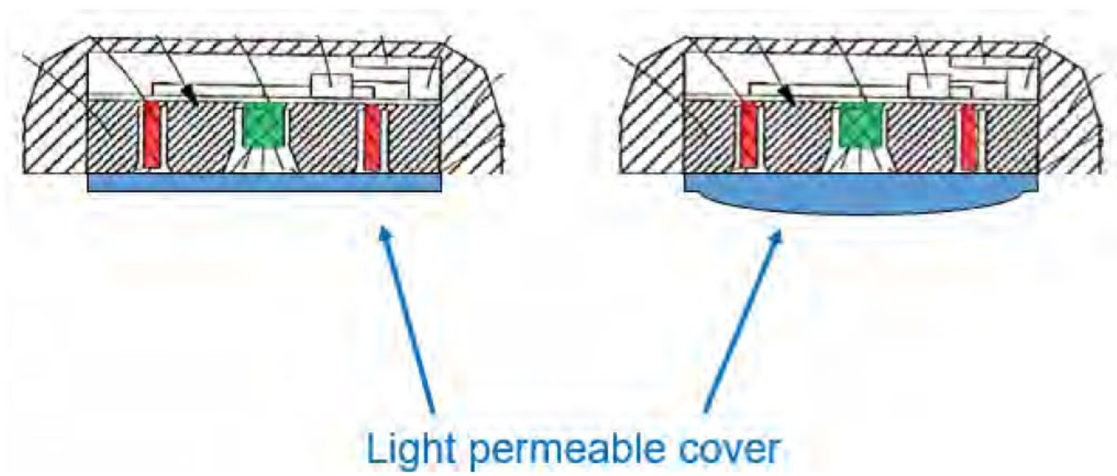
Petitioner, however, reasons that one of ordinary skill in the art would have "looked to Inokawa to enhance light collection efficiency, specifically by modifying the light permeable cover of Aizawa to include a convex lens." *Id.* In that regard, Petitioner points to Inokawa's Figure 2. Petitioner's annotated and colorized version of that figure is reproduced below.



Id. at 15. Figure 2 above shows a version of Inokawa's Figure 2 that emphasizes the shape of lens 27. Petitioner expresses that "Inokawa teaches that its cover may be either flat . . . such that 'the surface is less prone to scratches'" or may be in the form of the shape shown above to "increase the light gathering ability of the LED." *Id.* at 15 (quoting Ex. 1008 ¶ 15); *see*

Ex. 1003 ¶¶ 92–93. Petitioner contends that a person of ordinary skill in the art "wanting to achieve improved light collection efficiency over reduced scratch-suseptibility could have modified Aizawa's cover to have a lens shape as per Inokawa." Pet. 17 (citing Ex. 1003 ¶ 96). Petitioner also contends that a skilled artisan would have had a reasonable expectation of success in combining those teachings. *Id.* (citing Ex. 1003 ¶ 96). Petitioner adds that Aizawa's "transparent acrylic material . . . can be readily formed into a lens-like shape as in Inokawa." *Id.* (citing Ex. 1003 ¶ 96; Ex. 1023, Fig. 6, ¶¶ 22, 32, 35).

Petitioner colorized and annotated version of Aizawa's Fig. 1(b) (reproduced below) and contends the device resulting from the obvious combination of Aizawa and Onokawa would have replaced the flat cover (left) with a curved one as per Inokawa (right) to "increase the light-gathering ability." *Id.* at 15 (citing Ex. 1008 ¶ 15).



Id. at 16; *see* Ex. 1003 ¶ 94.

Further according to Petitioner: "[a person of ordinary skill in the art] would have understood how to implement Inokawa's lens-shaped cover in Aizawa's device with a reasonable expectation of success." Pet. 15–17 (citing Ex. 1008, Figs. 16, 17, ¶¶ 15, 106); Ex. 1003 ¶ 98. The shape of the

modified cover in Dr. Kenny's illustration of the proposed modification above is similar to the shape of an LED lens unit illustrated in Exhibit 1023[7] (hereafter "Nishikawa"), referenced by Petitioner and Dr. Kenny in in connection with the proposed unpatentability of claims of the '628 patent based on Aizawa and Inokawa. *Compare* Pet. 16–17 (illustrating proposed modification), *with* Ex. 1023, Fig. 6, ¶¶ 3, 22, 30, 32, 35 (illustrating lens unit 50 used with LED 22, and discussing how to make the illustrated device).

Limitation [1d] additionally reqiures that the outwardly protruding convex surface be "configured to cause tissue of the user to conform to at least a portion of the outwardly protruding convex surface." With respect to that tissue conforming aspect, Petitioner additionally reasons that Aizawa's light permeable cover "is designed to be pressed on to the skin of the user with pressure" (Pet. 29 (citing Ex. 1001 ¶¶ 6, 26; Ex. 1003 ¶¶ 97–98)) and that implementing the convex shape of Inokawa's lens in Aizawa's light permeable cover "will cause the tissue of the user to further conform around the convex surface of the lens/protrusion when the device is pressed against the tissue" (*id.* at 29–30 (citing Ex. 1003 ¶¶ 97–98)).

(2) Patent Owner's Contentions

Patent Owner contends that the evidence does not support Petitioner's argument that it would have been obvious to modify Aizawa's cover to have a convex protrusion, in order to improve detection efficiency by directing incoming light to Aizawa's photodetectors 22, with a reasonable expectation of success. PO Resp. 16–35; Sur-reply 1–14; Ex. 1004 ¶¶ 48–78.

[7] US 2007/0145255 A1, published June 28, 2007.

According to Patent Owner, the evidence establishes that Petitioner's proposed modification would direct light *toward the center* of Aizawa's detector 1 where emitter(s) 21 are located, rather than *toward the periphery* where detectors 22 are located. PO Resp. 16–19; Ex. 2004 ¶¶ 50–57. Thus, Patent Owner's view is that "a [person of ordinary skill in the art] would ***not*** have expected Inokawa's convex surface to accomplish" the objective of enhancing light collection efficiency relied upon by Petitioner, because Petitioner's proposed modification instead "would direct light ***away*** from the ***periphery***-located detectors" in Aizawa, the opposite result to Petitioner's contention. PO Resp. 19–22; Ex. 2004 ¶¶ 60–65.

In support, Patent Owner points to Inokawa's Figure 2, in which two arrows illustrate light that passes through the convex protrusion of lens 27 toward the center of Inokawa's pulse sensor 1 where detector 25 is located. PO Resp. 14 (citing Ex. 1008 ¶ 58); Ex. 2004 ¶¶ 43–44. Patent Owner also points to the '628 patent's Figure 14B, which illustrates several light rays 1420, 1422 passing through a partially cylindrical protrusion 605 to be centrally focused on detector(s) 1410B. PO Resp. 18–19 (citing Ex. 1001, 36:56–57, 35:64–66; Ex. 2004 ¶¶ 55–57). Patent Owner cites portions of Dr. Kenny's deposition testimony that, in Patent Owner's view, support Patent Owner's contentions in these regards. *See* PO Resp. 2, 18, 19, 23 (citing Ex. 2006, 83:15–84:2, 86:19–87:1, 202:11–204:20).

Patent Owner also asserts that "Dr. Kenny admitted that the impact of Inokawa's convex lens would not be 'obvious' in the context of [the] different configuration of LEDs and detectors" presented by Aizawa. PO Resp. 20 (citing Ex. 2006, 87:2–6). For example, Patent Owner points out that "light reaching Aizawa's detectors must travel in an opposite

direction from the light in Inokawa." *Id.* at 20–22 (citing Ex. 1006, Fig. 1(b); Ex. 1008, Fig. 2); Ex. 2004 ¶¶ 61–64. In addition, according to Patent Owner, "Petitioner's combination is particularly problematic because" Aizawa uses "small detectors [22] with small openings [of cavities 23c] surrounded by a ***large*** amount of ***opaque*** material." PO Resp. 22 (citing Ex. 1006, Fig. 1(a)); Ex. 2004 ¶ 65. In support of its view, Patent Owner cites portions of Dr. Kenny's deposition testimony. *See* PO Resp. 22 (citing Ex. 2006, 257:11–18).

Patent Owner further argues that Dr. Kenny, during his deposition, attempted to evade the foregoing problems with his declaration testimony by "disclaim[ing] Petitioner's reasoning [for obviousness] and assert[ing] new and improper opinions" that undermine the reasoning provided in the Petition. PO Resp. 2, 23–24 (citing Ex. 1003 ¶ 94; Ex. 2004 ¶ 66; Ex. 2006, 65:15–70:7, 108:21–109:14, 198:6–16, 202:11–204:20; Ex. 2009, 310:1–20). For example, Patent Owner asserts that Dr. Kenny's attempt to distinguish between the '628 patent's Figure 14B as illustrating a lens that condenses *collimated* light toward the center, and Aizawa and Inokawa in which the lens focuses *diffuse* light reflected by the user's body, is not persuasive and is not supported by record evidence. PO Resp. 24–25 (citing Ex. 2006, 170:9–171:5; Ex. 2007, 288:13–289:5, 294:17–298:10, 298:11–299:18, 423:7–424:18); Ex. 2004 ¶¶ 67–68. Patent Owner also objects to Dr. Kenny's testimony that, "while a convex lens would generally direct more light to the center," it "would also capture some light that otherwise would not be captured" by Aizawa's detectors 22, as lacking evidentiary support other than in the '628 patent itself which is impermissible hindsight. PO Resp. 25–26 (citing Ex. 1001, 7:61–63; Ex. 2004 ¶¶ 69–70; Ex. 2006,

204:21–206:5, 206:22–208:1; Ex. 2007, 294:17–298:10). Patent Owner moreover asserts that "Dr. Kenny repeatedly distanced himself from his own combination" of Aizawa and Inokawa by refusing to talk about the specific shape, size, material, and dimensional tolerances of the combination, so, in Patent Owner's view, his testimony falls short because it demonstrates at most only that the references could have been combined. *Id.* at 2–3, 26–30 (citing Ex. 1003 ¶¶ 94, 103; Ex. 2004 ¶¶ 71–72; Ex. 2006, 51:14–52:16, 75:20–77:2, 91:9–92:13, 96:20–21, 97:11–21, 100:17–101:18, 132:10–18, 154:4–7, 164:8–16, 189:11–190:3; Ex. 2007, 308:12–309:8, 310:18–311:9, 318:3–6, 324:21–325:19, 333:20–335:4).

Indeed, according to Patent Owner, because ordinary skill does not require specific education or experience with optics or optical physiological monitors (*see supra* Section II.B): "It strains credibility that a [person of ordinary skill in the art] . . . could balance all of the factors Dr. Kenny identified" as affecting the performance of a protruding convex lens in an optical physiological sensor to reach the claimed invention. PO Resp. 30–31 (citing Ex. 2004 ¶¶ 73–75; Ex. 2006, 51:21–52:16, 93:16–94:15, 100:17–101:18; Ex. 2009, 347:14–352:18). Patent Owner relies on Dr. Kenny's testimony as establishing the complexity of designing optical physiological sensors. *Id.* at 3–4, 31 (citing Ex. 2006, 86:19–87:6; Ex. 2007, 331:19–332:11, 336:11–337:15). Patent Owner concludes Petitioner has failed to establish a reasonable expectation of success in reaching the invention of claim 1 based on Aizawa and Inokawa, because Dr. Kenny's testimony on this issue "focuses almost entirely on manufacturing." *Id.* at 31–32 (citing Ex. 1003 ¶ 96; Ex. 2004 ¶ 75).

Patent Owner moreover asserts Petitioner errs in relying on Nishikawa as supporting the unpatentability of claim 1, because Nishikawa is "not identified as part of" Ground 1A, which instead "includes only two references," Aizawa and Inokawa. PO Resp. 32 (citing Pet. 1–2, 14; Ex. 1003 ¶¶ 91–96); *id.* at 34 (citing 35 U.S.C. § 312(a)(3); *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016)). Patent Owner asserts Dr. Kenny "relies heavily" on Nishikawa, particularly "to inform the specific shape of the cover in his combination, which is found nowhere in Aizawa and Inokawa." *Id.* at 32 (citing Pet. 28; Ex. 2004 ¶¶ 76–77; Ex. 2006, 179:21–180:13; Ex. 2007, 364:2–13; Ex. 2008, 73:8–12).

Furthermore, in Patent Owner's view, Dr. Kenny's reliance on Nishikawa "make[s] no sense" because "Nishikawa's device is not a physiological sensor" but rather is "an encapsulated LED" that "directs ***outgoing*** light through the encapsulation material and thus focuses on the emission of light, not the detection of an optical signal." PO Resp. 34 (citing Ex. 1023, code (57), ¶¶ 3, 32, 35; Ex. 2004 ¶ 78). Patent Owner contrasts such disclosure with Aizawa and Inokawa, both of which "detect[] ***incoming*** light that passes through the cover and reaches the detectors," and which have a "drastically" smaller scale than Nishikawa's LEDs. *Id.* at 34–35 (citing Ex. 1008, Fig. 2; Ex. 2004 ¶ 78).

(3) Petitioner's Reply

In reply, Petitioner insists "Inokawa's lens enhances the light-gathering ability of Aizawa," which would have motivated an ordinarily skilled artisan "to incorporate 'an Inokawa-like lens [having a convex protrusion] into the cover of Aizawa to increase the light collection

efficiency.'" Pet. Reply 2–3 (bolding omitted) (citing Pet. 14–16, 28; Ex. 1003 ¶¶ 91–96; Ex. 1008, Fig. 2, ¶¶ 15, 58). Petitioner dismisses Patent Owner's and Dr. Madisetti's opposition as being "misinformed" regarding Inokawa's lens and lenses in general, because "a [person of ordinary skill in the art] would understand that Inokawa's lens improves 'light concentration at pretty much all of the locations under the curvature of the lens,' as opposed to only at a single point at the center." *Id.* at 3–4 (quoting Ex. 2006, 164:8–16); *id.* at 1, 3–4 (citing PO Resp. 13; Ex. 1041, 89:12–19; Ex. 1042, 170:12–20); Ex. 1047 ¶¶ 3–5, 19–23.

For example, Petitioner contends that Patent Owner and Dr. Madisetti "ignore[] the well-known principle of reversibility" according to Snell's law.[8] Pet. Reply 4–7 (underlining omitted) (citing Ex. 1043, 80:20–82:20; Ex. 1049, 101, 106–111; Ex. 1052,[9,10] 84, 87–92); Ex. 1047 ¶¶ 31–39. Petitioner contends that Dr. Madisetti was evasive when he was asked to apply the reversibility principle to the combination of Aizawa and Inokawa in this case. Pet. Reply 6 (citing Ex. 1041, 89:12–19, 84:2–85:7).

Petitioner also asserts that Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue in the user's wrist, to be received by detectors in either Aizawa's or Inokawa's pulse sensor, will be

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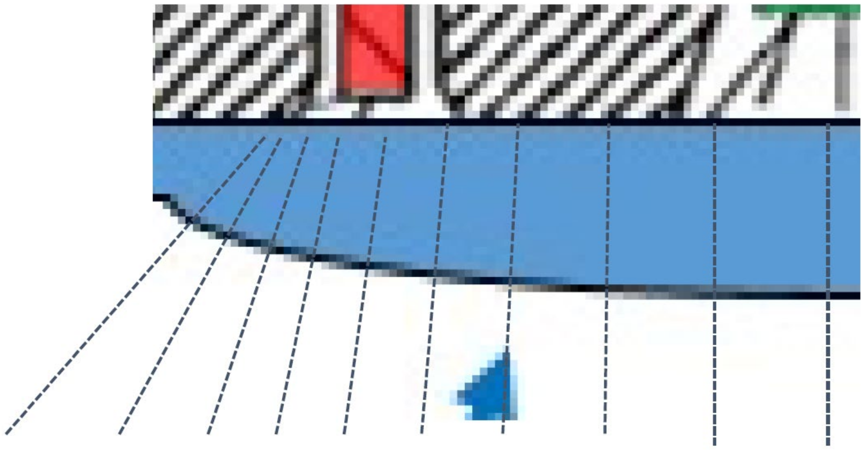
[8] Snell's law describes how a light ray will be refracted when passing between two mediums having different indices of refraction. *See* Ex. 1047 ¶ 10 (describing and illustrating Snell's law).

[9] Eugene Hecht, *Optics* (2nd ed. 1990).

[10] It is apparent that the page numbering identified by Petitioner for Exhibit 1052 refers to the documents native page numbering and not the page numbering of the exhibit appearing at the bottom, middle of each page. For clarity and consistency, in this Decision, we also use the same page numbering as Petitioner for Exhibit 1052.

"scattered" and "diffuse" and, therefore, will approach the detectors "from various random directions and angles." Pet. Reply 7–8 (citing Ex. 1046, 803; Ex. 2012, 52, 86, 90); *id.* at 8–10 (annotating Inokawa's Fig. 2 to illustrate the cause and nature of the back-scattering); Ex. 2020 ¶ 128; Ex. 1047 ¶¶ 6–9. This scattered and diffuse light, according to Petitioner, means that Inokawa's "lens cannot focus all incoming light at a single point" at a central location as Patent Owner would have it. Pet. Reply 8 (citing Ex. 1047 ¶ 6; Ex. 2006, 163:12–164:2). Petitioner asserts this is due to Snell's law, and provides several illustrations to illustrate why. *Id.* at 8–13 (citing Ex. 1043, 80:20–82:20; Ex. 1049, 101; Ex. 1052, 84; Ex. 1047 ¶¶ 6–18; Ex. 2012, 52, 86, 90; Ex. 2020 ¶ 128).

Due to the random nature of this scattered light, Petitioner explains that one of ordinary skill in the art would have understood that "Inokawa's lens provides at best a slight refracting effect, such that light rays that otherwise would have missed the detection area are instead directed toward that area as they pass through the interface provided by the lens." Pet. Reply 14 (citing Ex. 1047 ¶ 18). Petitioner applies this understanding to Aizawa, and contends that using a lens with a convex protrusion in Aizawa would "enable backscattered light to be detected within a circular active detection area surrounding" a central light source, thereby "allowing a larger fraction of the backscattered light to reach the areas covered by the lens" including the circular detection area. *Id.* (citing Ex. 1047 ¶ 18–22; Ex. 1046, 803; Ex. 2006, 164:8–16, 204:21–205:12; Ex. 2012, 86, 90). Dr. Kenny provides the following illustration of this alleged effect. *See* Ex. 1047 ¶ 21; Pet. Reply 14.



Here, Dr. Kenny has excerpted a portion of his illustration of using a lens with a convex protrusion (in blue) on top of Aizawa's pulse rate detector (with a photodetector, in red) (*see* Ex. 1003 ¶ 94), and added several dotted lines that are orthogonal to the lens surface. Pet. Reply 15–16; Ex. 1047 ¶¶ 20–22. Dr. Kenny testifies that Snell's law indicates "the incoming light rays are refracted in a way that deflects incoming rays somewhat towards these orthogonal lines," and that because "these orthogonal lines vary in orientation most rapidly near the edge, where the illustrated curvature of the lens surface is the greatest," using this lens in Aizawa "would lead to an improvement in the light concentration at the location of the detectors." Ex. 1047 ¶¶ 21–22.

Petitioner further contends that one of ordinary skill in the art, upon reading Inokawa's disclosure that its lens 27 "makes it possible to increase the light-gathering ability of the LED" in an optically-based pulse sensor device (Ex. 1008 ¶ 15), would have understood that this "general benefit" could also be achieved within the context of Aizawa's optically-based pulse sensor device, and is not limited to "the exact" structure of Inokawa's device. Pet. Reply 16 (citing Ex. 1003 ¶¶ 60, 93–95; Ex. 1047 ¶ 23; Ex. 2006, 88:21–89:1, 89:21–90:3).

Petitioner additionally argues that Dr. Madisetti's testimony in support of Patent Owner's position ignores the application of Snell's law to the random nature of backscattered light in the context of Aizawa's and Inokawa's pulse sensors, which measure light *reflected* (i.e., backscattered) by the user's tissue. Pet. Reply 14 (citing Ex. 1042, 166:12–182:3); Ex. 1047 ¶ 17. Petitioner similarly dismisses the applicability of Figure 14B of the '628 patent as illustrating the operation of a *transmittance*-type of sensor that measures the attenuation of collimated light transmitted through the user's body tissue, rather than the *reflectance*-type sensors of Aizawa and Inokawa. *Id*. at 18–19 (citing Ex. 1001, 35:62–64, Fig. 14I; Ex. 1047 ¶¶ 24–28; Ex. 2007, 287:12–289:5).

Petitioner further maintains that Patent Owner's argument that Petitioner's illustrations of the light-focusing properties of a convex lens discussed in the Petition filed in IPR2020-01520 (Ex. 2019, 39) and relied upon by Dr. Kenny (Ex. 2020, 119–120) does not demonstrate "that a convex lens directs all light to the center." Pet. Reply 18–19 (citing PO Resp. 16–17, 23; Ex. 1041, 41:7–22, 60:7–61:6). Petitioner contends these illustrations, instead, "are merely simplified diagrams included to illustrate . . . one example scenario (based on just one ray and one corpuscle) where a light permeable cover can 'reduce a mean path length of light traveling to the at least four detectors'" as recited in claim 12. *Id.* (citing Pet. 39; Ex. 2020 ¶¶ 119–120; Ex. 1047 ¶¶ 29–30).

(4) Patent Owner's Sur-reply

Patent Owner submits that Petitioner's Reply improperly presents several new arguments, relying on new evidence, as compared with the Petition. *See, e.g.*, Sur-reply 3 n.3 (objecting to the illustration provided at

Pet. Reply 14 as being "new"); *id.* at 5 ("After recognizing the fundamental error in its proposed combination, Petitioner now attempts to rewrite its petition" concerning how a lens with a convex protrusion would focus light in Aizawa's device); *id.* at 7 ("Petitioner's new theory [concerning reversibility of light rays] is improper, denying [Patent Owner] of the opportunity to respond with expert testimony, and should be rejected."); *id.* at 10 ("Petitioner next asserts a number of other new theories found nowhere in the petition.").

Patent Owner also contends that Petitioner mischaracterizes Patent Owner's position, which is not that Inokawa's lens with a convex protrusion "direct[s] '***all***' light 'only at a ***single point*** at the center'" of the sensor as Petitioner characterizes it. Sur-reply 1–2 & n.2 (quoting Pet. Reply 3–4, and citing PO Resp. 2, 14–17, 23–25, 27 and Ex. 2027, 63:7–64:6, 94:20–96:1, 96:18–97:7). Patent Owner's position, rather, is that Inokawa's lens condenses more light (not necessarily all light) "***towards*** a more central location" (not necessarily at a single, central point) relative to Aizawa's flat cover. *Id.* at 2–3 (quoting PO Resp. 18, and citing Ex. 2004 ¶¶ 34, 44, 51, 53, 54, 57, 67).

Patent Owner moreover asserts "[t]here can be no legitimate dispute that a convex surface directs light centrally (and away from the periphery)," so Petitioner errs in its view that a [person of ordinary skill in the art] would have used a convex lens with Aizawa's detector 1 to improve its light detection efficiency, because Aizawa's photodetectors 22 are disposed at the periphery of the device. Sur-reply 3–6 (citing PO Resp. 15–18; Ex. 2006, 164:8–16, 166:10–17, 170:22–171:5; Ex. 2020 ¶¶ 119, 200; Ex. 2027, 181:9–182:5). Patent Owner contends that Petitioner's argument "that

Inokawa would improve light-gathering at all locations, ***regardless*** of the location of the LEDs and detectors" is belied by Dr. Kenny's testimony that "Inokawa's benefit would ***not*** be clear if Inokawa's LEDs and detectors were moved" and "confirmed that a convex surface would direct light toward the center of the underlying sensor." *Id.* at 6 (citing Pet. Reply 3–4; Ex. 2006, 86:19–87:6, 202:11–204:20).

Patent Owner argues that Petitioner's discussion of the principle of reversibility is "irrelevant" because it "assumes ideal conditions that are not present when tissue scatters and absorbs light." Sur-reply 7–8 (citing Ex. 2027, 17:12–19:2, 29:11–30:7, 31:8–32:3, 38:17–42:6, 207:9–209:21, 210:8–6). The random nature of backscattered light, in Patent Owner's view, "hardly supports Petitioner's argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed," and is irrelevant to the central issue presented here of "whether a convex surface—***as compared with a flat surface***—would collect and focus additional light on Aizawa's peripherally located detectors." *Id.* at 8–9 (citing Ex. 2006, 86:19–87:6; Ex. 2027, 212:3–14).

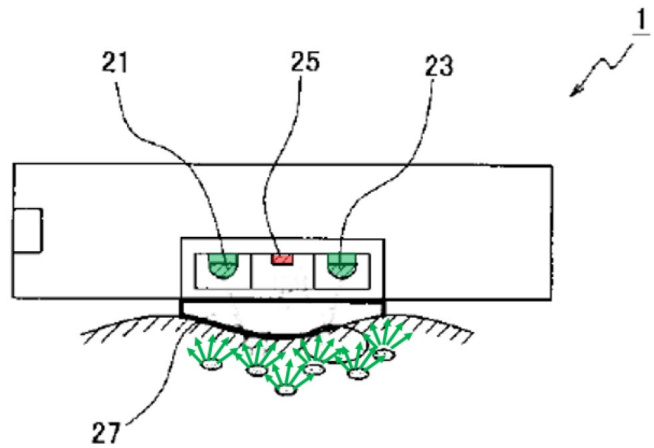
In response to Petitioner's argument that "due to its protruded shape, Inokawa's lens 'provides an opportunity to capture some light that would otherwise not be captured'" in Aizawa (Pet. Reply 15), Patent Owner asserts that "Dr. Kenny was unable to support this new theory with any evidence." Sur-reply 11 (citing Ex. 2007, 294:17–298:10). Patent Owner further contends that Petitioner "fails to consider the greater ***decrease*** in light at the detectors due to light redirection to a ***more*** central location." *Id.* at 13 (citing Pet. Reply 20; Ex. 2027, 19:16–21:8). Patent Owner expresses that "the circle of backscattered light's intensity '***decreases*** in direct proportion

to the ***square of the distance*** between the photodetector and the LEDs,'" so "any purported signal obtained from light redirected from the sensor's ***edge*** would be relatively weak and fail to make up for the much greater loss of signal strength when light is redirected away from the detectors and towards a more central position." *Id.* (citing Ex. 1015, 168; Ex. 2027, 49:17–50:13, 57:10–22).

(5) Discussion

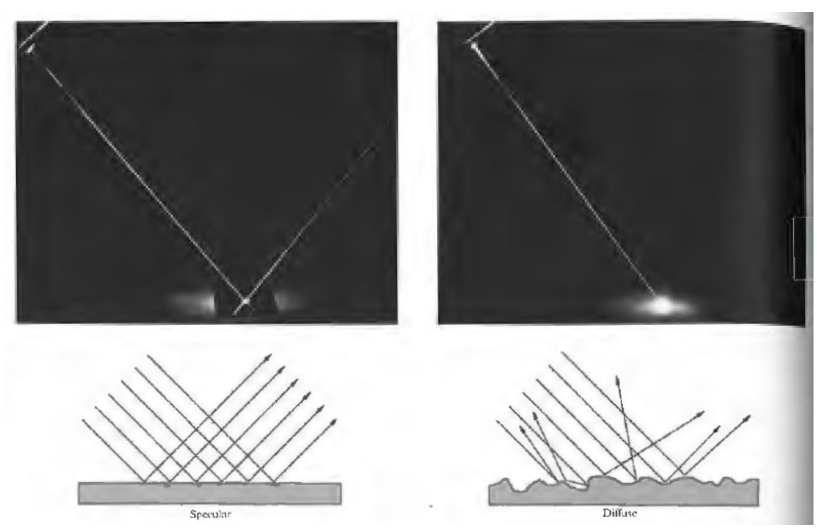
Upon review of the foregoing, we conclude that a preponderance of the evidence supports Petitioner's view that it would have been obvious to modify Aizawa's cover 6 to include a convex lens or protrusion like that taught in Inokawa, in order to increase the amount of backscattered light that will be received by Aizawa's four peripheral detectors 22, as compared with Aizawa's existing flat cover.

It is clear that Aizawa's and Inokawa's pulse sensors both gather data by emitting light into the user's wrist tissue, and collecting light that reflects back to the sensor from within the user's tissue. *See, e.g.*, Ex. 1006, Figs. 1(b), 2 (sensor 2 has emitter 21 and four detectors 22, all facing a user's wrist 10); Ex. 1008, Figs. 1, 2 (sensor 1 has two emitters 21, 23 and one detector (photodiode 25), all facing the user's wrist when held in place by wristband 5). Dr. Kenny testifies, and Patent Owner agrees, that the reflection of this light by the user's wrist tissue randomizes the propagation direction of the reflected light rays. *See* Ex. 1003 ¶ 128; Ex. 1047 ¶¶ 6–7; Ex. 2020 ¶ 128; Sur-reply 7–8 ("Even Petitioner admits that tissue randomly scatters and absorbs light rays . . . ."). This reflection principle is illustrated by Dr. Kenny's annotations to Inokawa's Figure 2 reproduced below:



Here, Dr. Kenny has modified Inokawa's Figure 2 (1) by removing two black arrows, (2) by coloring Inokawa's light detector in red and Inokawa's two light emitters in green, and (3) by adding several green arrows to illustrate the various directions that light rays may be directed after impinging on and reflecting off different tissues in the user's wrist. Ex. 1047 ¶¶ 6–7.

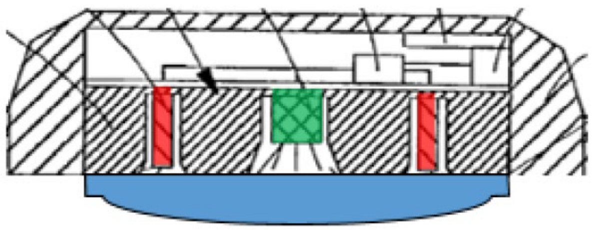
This randomized direction of reflected light rays results in backscattered light that is diffuse, rather than collimated, in nature. Figure 4.12 of Exhibit 1052 illustrates the difference between diffuse and collimated light, and is reproduced below:

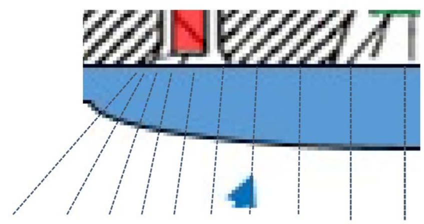


This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a photograph and an illustration of incoming collimated light reflecting from a rough surface. *See* Ex. 1052, 87–88. The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. *See id.* The rough surface provides diffuse reflection, in which the reflected light rays travel in random directions. *See id.*

This diffuse nature of the light reflected from the user's wrist tissue, which both Aizawa and Inokawa aim to collect to generate pulse data, suggests that a lens might be useful to increase the amount of collected light and thereby increase the reliability of the pulse data generated using the collected light. Indeed, that is taught by Inokawa. Inokawa describes using its lens 27 to "increase the light-gathering ability" of Inokawa's light photodiode or detector 25. Ex. 1008 ¶¶ 15, 58. Although Inokawa refers to the "LED" such as emitters 21, 23 in that regard (*id.* ¶ 15), rather than photodiode 25, it is undisputed that photodiode 25 is the only component of Inokawa's sensor 1 that gathers light. Furthermore, there is also no dispute that Inokawa's lens 27 is understood to be shaped as a convex protrusion. *See, e.g.*, Ex. 1003 ¶¶ 92–93 (characterizing Inokawa as teachings a "convex protrusion that acts as a lens"); PO Resp. 1 (describing Inokawa as teaching a "convex lens"). Thus, Inokawa demonstrates that it was known in the art prior to the '628 patent to use a lens comprising a convex protrusion to focus diffuse light reflected from body tissue on to the light detecting elements of a wrist-worn pulse sensor, and to increase the light gathered by the sensor thereby improving the device's calculation of the user's pulse.

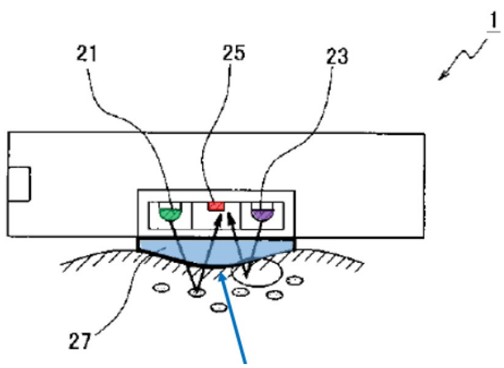
A preponderance of the evidence supports Petitioner's view that it would have been obvious for a person of ordinary skill in the art to apply Inokawa's lens technology to Aizawa's wrist-worn pulse sensor, so as to improve its light collection in a similar manner versus Aizawa's existing flat cover. That is illustrated by the following illustrations provided by Dr. Kenny:

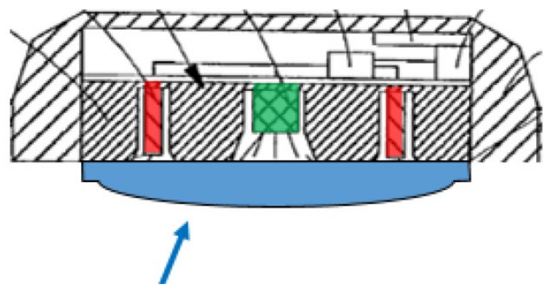




The illustration at left modifies Aizawa's Figure 1(b) to show how Aizawa's existing flat cover may be modified to incorporate a convex protrusion (in blue) to act as a light-focusing lens, which covers Aizawa's four peripheral light detectors (two shown in red) and central light emitter (colored green). *See* Ex. 1003 ¶ 94. The illustration at right zooms in on the portion of this modification covering one of the detectors, and adds several dotted lines that are orthogonal to the lens surface. *See* Ex. 1047 ¶¶ 20–21. We are persuaded by Dr. Kenny's testimony that Snell's law indicates "the incoming light rays are refracted in a way that deflects incoming rays somewhat towards these orthogonal lines," and that because "these orthogonal lines vary in orientation most rapidly near the edge, where the illustrated curvature of the lens surface is the greatest," using the illustrated lens taught by Aizawa and Inokawa "would lead to an improvement in the light concentration at the location of the detectors." *Id.* ¶¶ 18–22 (applying Snell's law to the prior art); *id.* ¶¶ 8–17 (discussing Snell's law in the abstract).

Patent Owner correctly notes that Inokawa's single detector 25 is located in the central portion of Inokawa's sensor 1, whereas Aizawa's four detectors 22 are located more towards the periphery of Aizawa's sensor 2. *Compare* Ex. 1008, Fig. 2, *with* Ex. 1006, Figs. 1(a)–1(b). Nevertheless, Petitioner's proposed modification of Aizawa takes that circumstance into account, as can be seen by the following comparison between Inokawa's sensor and Petitioner's proposed modification of Aizawa's sensor:





The illustration at left annotates Inokawa's Figure 2 to identify the central detector in red and the lens in light blue (*see* Ex. 1003 ¶ 95), and the illustration at right annotates Petitioner's proposed modification of Aizawa to illustrate the peripheral detectors in red and the lens in light blue (*see id.* ¶ 97). As can be seen, the lenses are not identical. In Inokawa the lens's curvature is most pronounced at the center of the lens near the central detector, and in the proposed modification to Aizawa, the lens's curvature is most pronounced at the edges of the lens near the peripheral detectors. Thus, Dr. Kenny's proposed modification of Aizawa takes Inokawa's general teaching of using a convex protrusion lens to increase the amount of incoming light directed to a light detector, and applies it to the four light detectors of Aizawa. *See, e.g.*, *id.* ¶¶ 95–97; Ex. 1047 ¶¶ 8–22.

We are cognizant of Patent Owner's contention that Petitioner's ground "improperly" relies upon a reference, Nishikawa, that was not

identified as a part of the ground of unpatentability styled as being based on Aizawa and Inokawa. PO Resp. 32. As Patent Owner observes, Dr. Kenny characterizes his testimony as being "inspired by" or "motivated" in part based on Nishikawa's disclosure when it comes to the shape of a convex lens. *See, e.g.*, PO Resp. 33–34 (citing Ex. 2006, 179:21–180:13; Ex. 2007, 364:2–13; Ex. 2008, 73:8–12). We, however, disagree with Patent Owner that any impropriety arises from Dr. Kenny's contemplation of the teachings of Nishikawa in connection with a convex shape of a lens for a physiological sensor. The nature of Petitioner's and Dr. Kenny's consideration of Nishikawa is explained in the Petition, even if Nishikawa is not listed as a third reference in the identification of the ground. *See* Pet. 16–17 (discussing Nishikawa (Ex. 1023) and Dr. Kenny's testimony concerning Nishikawa (Ex. 1003 ¶¶ 95, 96) in proposing the unpatentability of claims of the '628 patent.) Indeed, it follows readily from the Petition that a skilled artisan would have appreciated that Nishikawa's teachings provide insight as to how "the transparent acrylic material used to make Aizawa's plate can be readily formed into a lens-like shape as in Inokawa." Pet. 17. Nishikawa describes how its "lens unit 50" can be a transparent resin formed in the shape illustrated in Figure 6 by injection molding. Ex. 1023 ¶¶ 22, 32, 35. Dr. Kenny also explains that Nishikawa's lens shape design "is intended to provide curvature in the lens where it can do the most good and otherwise try to avoid excess use of material in order to create curvature in locations where it wouldn't do any good." Ex. 2006, 179:21–180:13 (emphasis added).

Moreover, we observe that a rejection based on obviousness "require[s] an analysis that reads the prior art in context, taking account of

'demands known to the design community,' 'the background knowledge possessed by a person having ordinary skill in the art,' and 'the inferences and creative steps that a person of ordinary skill in the art would employ.'" *Randall Mfg. v. Rea*, 733 F.3d 1355, 1362 (Fed. Cir. 2013) (quoting *KSR*, 550 U.S. at 418). Furthermore, record evidence can be useful to "demonstrate the knowledge and perspective one of ordinary skill in the art." *Id.; see also Ariosa Diagnostics v. Verinata Health Inc.,* 805 F.3d 1359, 1365 (Fed. Cir. 2015) ("Art can legitimately serve to document the knowledge that skill artisan would bring to bear in reading the prior art identified as producing obviousness.")

As noted above, Dr. Kenny makes clear that his view as to obviousness of the claims of the '628 patent was "inspired by" or "motivated" in part by Nishikawa's teachings as to shapes generally known to those in the art in considering manufacturing a lens. *See, e.g.*, Ex. 2007, 364:2–13; Ex. 2008, 73:12–21. We conclude that the record establishes that Nishikawa's teachings are representative of background knowledge of one of ordinary skill in the art and provide context and perspective of a skilled artisan as to the type of shapes available for the convex protruding surface disclosed in Inokawa. That Dr. Kenny considered record evidence cited in the Petition as informing his view of what a skilled artisan would understand as to known types of lens shapes as a part of the Aizawa and Inokawa ground does not establish, in our view, any impropriety as part of that ground.

Patent Owner also contends that Petitioner's modification of Aizawa "fails to consider the greater ***decrease*** in light at the detectors due to light redirection to a ***more*** central location." Sur-reply 12–13 (citing Ex. 1015,

168; Ex. 2027, 19:16–21:8, 49:17–50:13, 57:10–22). Dr. Kenny acknowledges that, when a convex protrusion is added to Aizawa's flat cover, "*some* . . . [light] rays that would have hit the detectors [using a flat cover] are refracted away from the detectors" by the convex protrusion. *See* Ex. 2027, 19:16–21:8 (emphasis added). Dr. Kenny also acknowledges "there is a decrease in the light as you move away from the location of the emitter towards the perimeter of the sensor," which is a "rapid" decrease, perhaps "with the square of the distance" or "exponential[ly]." *Id.* at 49:1–50:13, 57:10–22.

Dr. Kenny, nonetheless, maintains that a person of ordinary skill in the art "would understand how to take advantage of the detector locations and the shape of this convex surface *so as to obtain an improvement [in Aizawa] in the amount of light arriving at the detectors*," despite the foregoing considerations. *Id.* at 20:9–22:18 (emphasis added) (citing Ex. 1047 ¶ 44), 213:12–19, 214:6–215:6. That testimony is persuasive. In particular, the difference in the length traveled by the light rays depending on whether Aizawa's wrist-worn sensor 2 uses a flat plate 6 or a convex plate 6 is extremely small. *See, e.g.*, Ex. 1006, Fig. 1(b), ¶ 26 (dotted line arrows show paths of light from emitter 21 to reflect off artery 11 in wrist 10 and return to detectors 22); *id.* at Fig. 2 (showing detector 1 mounted on a user's wrist, suggesting the general scale of detector 1); Ex. 1047 ¶¶ 8–22 (discussing typical light refractions by lenses in wrist-worn pulse sensors). Based on this scale, it is reasonable to conclude, as Dr. Kenny does, that the central light *lost* by adding a protrusion will be outweighed by the peripheral light *gained* by adding a protrusion, despite the greater distance traveled by

the peripheral light rays and the concomitant loss of intensity acknowledged by Dr. Kenny.

Patent Owner additionally asserts, and Dr. Madisetti testifies, that Petitioner's combination of Aizawa and Inokawa is "problematic" because it overlooks the "small" size of Aizawa's detectors 22 and the openings or cavities 23c in which they are housed. *See* PO Resp. 22 (citing Ex. 1006, Figs. 1(a)–1(b), Ex. 2004 ¶ 65; Ex. 2006, 257:11–18). Patent Owner, however, does not meaningfully articulate what significance the size of Aizawa's detector components have in the obviousness evaluation based on the teachings of the prior art.

We additionally do not agree with Patent Owner's argument that Petitioner's Reply presents new arguments and evidence that should have been first presented in the Petition. *See, e.g.*, Sur-reply 2–14. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, for the purpose of increasing the light gathering ability of Aizawa's device. *See, e.g.*, Pet. 13–17. Patent Owner, in its Response, then challenged that contention with several arguments that Petitioner's proposed convex protrusion would not operate in the way the Petition alleges it would operate. *See, e.g.*, PO Resp. 12–41. In its Reply, Petitioner proceeded to provide arguments and evidence attempting to rebut the contentions in the Patent Owner Response. *See* PTAB Consolidated Trial Practice Guide (Nov. 2019)[11], 73 ("A party also may submit rebuttal evidence in support of its reply."). The Reply does not change Petitioner's theory for obviousness; rather, the Reply presents more argument and evidence in support of the

[11] Available at https://www.uspto.gov/TrialPracticeGuideConsolidated.

same theory for obviousness presented in the Petition. *Compare* Pet. 13–16, *with* Reply 2–20.

Patent Owner finally argues that a conclusion of obviousness "strains credibility" because the level of ordinary skill in the art (*see supra* Section II.B) does not require specific education or experience with optics or optical physiological monitors. *See, e.g.*, PO Resp. 30–31. We disagree. Concerning motivation, an ordinarily skilled artisan would have readily appreciated from the record at hand that: (1) Aizawa's detector 1 operates by gathering light data with its photodetectors 22; (2) an optical lens would be useful to focus the light on to the photodetectors; and (3) optical lenses often are formed by providing a convex protrusion in the lens to focus light. Indeed, Inokawa discloses such utility, function, and structure as a part of its convex lens. *See, e.g.*, Ex. 1008 ¶¶ 15, 58, Fig. 2.

Concerning reasonable expectation of success in using a convex protrusion lens to increase the amount of light directed to Aizawa's photodetectors, we rely on Dr. Kenny's testimony that a person of ordinary skill in the art would have understood that a lens operates by increasing the light concentration most where the curvature of the lens is the greatest, which leads to Dr. Kenny's proposed lens for use in Aizawa. *See, e.g.*, Ex. 1003 ¶¶ 92–95; Ex. 1047 ¶¶ 8–10, 15–22; Ex. 2006, 179:21–180:13, 202:11–20. We are persuaded that a person of ordinary skill in the art would have understood this general concept of optics.

Thus, we conclude that one of ordinary skill in the art would have had adequate reason to replace Aizawa's flat cover 6 with a cover comprising a convex protrusion, to improve light detection efficiency, and would have had a reasonable expectation of success in doing so.

v. Summary

Based on the foregoing arguments and evidence, we conclude that Petitioner has demonstrated by a preponderance of the evidence that claim 1 would have been obvious over Aizawa and Inokawa.

4. Claims 2–15, 17, 20–26, and 28

As with claim 1, Petitioner provides argument and evidence, including testimony from Dr. Kenny, in support of its position that claims 2–15, 17, 20–26, and 28 are unpatentable over Aizawa and Inokawa. Pet. 30–43. Claims 2–6 ultimately depend from claim 1. Claims 7 and 20 are independent claims that are similar in scope to claim 1. Claims 8–15, 21–26, and 28 ultimately depend from either claim 7 or claim 20. Patent Owner does not advance any arguments for claims 2–15, 17, 20–26, and 28 that are distinct from those provided for claim 1. For the same reasons set forth in section II.D.3 above, we find Patent Owner's arguments unavailing as to claims 2–15, 17, 20–26, and 28. We conclude that Petitioner has established by a preponderance of the evidence that claims 2–15, 17, 20–26, and 28 are also unpatentable based on Aizawa and Inokawa.

E. Obviousness over Aizawa, Inokawa, and Ohsaki

Petitioner also contends that claims 1–15, 17, 20–26, and 28 of the '628 patent would have been obvious over the combined teachings of Aizawa, Inokawa, and Ohsaki. Pet. 43–46.

1. Overview of Ohsaki (Ex. 1014)

Ohsaki is a U.S. patent application publication titled "Wristwatch-type Human Pulse Wave Sensor Attached on Back Side of User's Wrist," and

discloses an optical sensor for detecting a pulse wave of a human body. Ex. 1014, code (54), ¶ 3. Figure 1 of Ohsaki is reproduced below.

FIG. 1

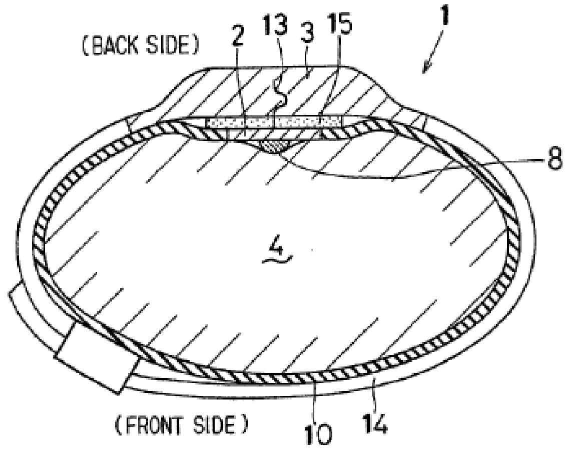


Figure 1 illustrates a cross-sectional view of pulse wave sensor 1 attached on the back side of user's wrist 4. *Id.* ¶¶ 12, 16. Pulse wave sensor 1 includes detecting element 2 and sensor body 3. *Id.* ¶ 16.

Figure 2 of Ohsaki, reproduced below, illustrates further detail of detecting element 2.

FIG. 2

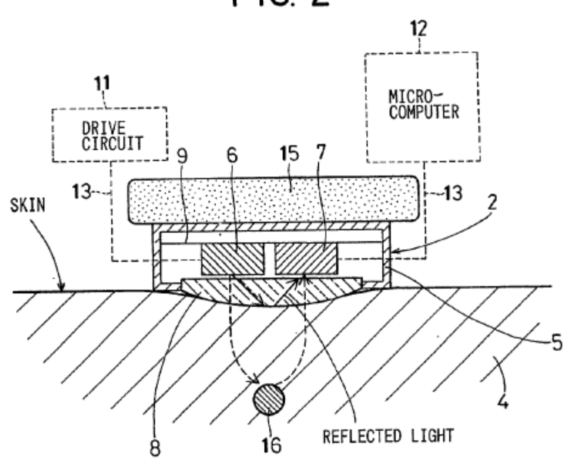


Figure 2 illustrates a mechanism for detecting a pulse wave. *Id.* ¶ 13. Detecting element 2 includes package 5, light emitting element 6, light receiving element 7, and translucent board 8. *Id.* ¶ 17. Light emitting

element 6 and light receiving element 7 are arranged on circuit board 9 inside package 5. *Id.* ¶¶ 17, 19.

"[T]ranslucent board 8 is a glass board which is transparent to light, and attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8." *Id.* ¶ 17. "[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin," preventing detecting element 2 from slipping off the detecting position of the user's wrist. *Id.* ¶ 25. By preventing the detecting element from moving, the convex surface suppresses "variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin." *Id.*

2. Discussion

As noted above, we conclude that Petitioner has established that claims 1–15, 17, 20–26, and 28 would have been obvious over the combined teachings of Aizawa, and Inokawa. Petitioner points to Ohsaki as providing "additional motivation and rationale for a [person of ordinary skill in the art] to modify Aizawa to include a 'light permeable cover comprising a protrusion' as per element [1d]." Pet. 45 (citing Ex. 1003 ¶¶ 142–146). In that regard, Petitioner contends that "Ohsaki teaches that adding a convex surface to the light permeable cover (i.e., translucent board 8) can help prevent the device from slipping on the tissue when compared to a flat cover." *Id.* at 45–46 (citing Ex. 1014 ¶ 25; Ex. 1003 ¶ 144). Petitioner also contends that a person of ordinary skill in the art "reviewing Aizawa and Ohsaki would have recognized Ohsaki's use of a convex protrusion in its

light permeable cover as a desirable configuration that would help to further prevent slippage of Aizawa's device." *Id.* at 46.

Patent Owner first contends that Ohsaki does not remedy the proposed deficiencies that it had argued with respect to the teachings of Aizawa and Inokawa, e.g., a sensor having multiple emitters and at least four detectors. PO Resp. 42–43. As discussed above, however, we do not agree that the teachings of the prior art are deficient as to such features.

Patent Owner also challenges Petitioner's position that a skilled artisan would have viewed Ohsaki's teachings as providing reason to implement a convex surface as a part of Aizawa's sensor device. In that regard, Patent Owner discounts Ohsaki's teachings of a convex cover as providing any slippage alleviating benefit if such a cover is implemented in Aizawa's sensor device. PO Resp. 43–45; Sur-reply 17–20.

We do not agree with Patent Owner. Patent Owner maintains that any benefits that Ohsaki attributes to a convex protrusion are realized only when a sensor and convex surface are placed on the back of the user's wrist, which is alleged to be opposite side of the wrist taught by Aizawa. Yet, we note that Petitioner does not propose bodily incorporating the references; Petitioner simply proposes adding a convex cover to Aizawa's sensor, without discussing where Aizawa's sensor is used. *See, e.g.*, Pet. 45–46. In other words, Petitioner's proposed modification does not dictate any particular placement, whether on the palm side or back side of the wrist.

To be sure, Ohsaki's Figures 3A–3B compare the performance of detecting element 2, including its translucent board 8 having a convex protrusion, and show better performance for a user in motion when the element is attached to the back side of the wrist versus the front side of the

wrist. *See* Ex. 1014 ¶¶ 23–24, Figs. 3A–3B. We, however, do not agree that these figures support Dr. Madisetti's conclusion that "Ohsaki indicates a convex surface only prevents slipping on the back (i.e., watch) side of the wrist in a specific orientation, but tends to slip when used in different locations or orientations" such as the palm side of the wrist—particularly in comparison to a flat surface such as Aizawa's. *See, e.g.*, Ex. 2004 ¶¶ 93. Instead, Ohsaki acknowledges that, even when the detecting element is located "on the front [palm] side of the user's wrist 4, *the pulse wave can be detected well* if the user is at rest." Ex. 1014 ¶ 23 (emphasis added). Thus, Ohsaki discloses that, in at least some circumstances, a convex surface located on the front of the user's wrist achieves benefits. *Id.* Notably also, the claims of the '628 patent are not limited to detection during movement or exercise.

Dr. Kenny testifies that a person of ordinary skill in the art would have understood from Ohsaki that a convex protrusion will help prevent slippage, even in the context of Aizawa's sensor. *See* Ex. 1003 ¶¶ 144–145; Ex. 1047 ¶¶ 50–52. In our view, Dr. Kenny's testimony is consistent with the plain disclosure of Ohsaki. We are cognizant of Dr. Madisetti's opposing testimony. *See, e.g.*, Ex. 2004 ¶¶ 93–95. For instance, Dr. Madisetti testifies that: (1) Ohsaki's disclosure on this point is "exceptionally limited" (*id.* ¶ 93); (2) "a [person of ordinary skill in the art] would have believed that adding Ohsaki's protruding surface would have disrupted the improved adhesion properties reported for Aizawa's flat plate" (*id.* ¶ 95); and (3) Ohsaki's teachings are "incompatible with Aizawa's sensor" (*id.*).

We do not disagree with Dr. Madisetti's views as to what a skilled artisan would have gleaned from the teachings of the prior art. It is true that Aizawa's plate 6 is illustrated as having a flat surface (Ex. 1006, Fig. 1(b)), and that Aizawa states the plate "improve[s] adhesion" (*id.* ¶ 13). Aizawa further states: "the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10," and "[t]hereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶ 26. Those disclosures, however, indicate that the improved adhesion is provided by the acrylic material of plate 6, not the shape of the surface of the plate, which is never specifically addressed. *See also id.* ¶¶ 30, 34 ("Since the acrylic transparent plate 6 is provided . . . adhesion between the pulse rate detector 1 and the wrist 10 can be improved . . . ."). Aizawa does not associate this benefit of improved adhesion with the surface shape of the plate, but rather, with the existence of an acrylic plate to begin with.

Furthermore, Ohsaki clearly teaches that the convex surface of its translucent board 8 "is in intimate contact with the surface of the user's skin" such that "it is prevented that the detecting element 2 slips off the detecting positions of the user's wrist 4." Ex. 1014 ¶ 25; *see also id.* ¶ 27 ("The detecting element 2 is stably fixed to the user's wrist 4."). We credit Dr. Kenny's testimony, over that of Dr. Madisetti, that a skilled artisan would have been motivated by such teachings to apply a cover with a convex surface to Aizawa to improve that similar device in the same way and to yield predictable results, i.e., to resist movement of the sensor on the user's wrist. *See, e.g.*, *See* Ex. 1003 ¶¶ 144 ("[a]mong other thing, Ohsaki teaches that adding a convex surface to its translucent board 8 (i.e., light permeable cover) can help prevent the device from slipping on the tissue of

the wearer compared to using a flat cover without such a protrusion" (citing Ex. 1014 ¶ 25)), 145 ("a [person of ordinary skill in the art] in possession of both Aizawa and Ohsaki would have recognized that Ohsaki's addition of a convex protrusion to its light permeable cover could be similarly implemented in Aizawa's device to help achieve the two references' shared goal of minimizing slippage" (citing Ex. 1006 ¶¶ 26, 30)); Ex. 1047 ¶¶ 50–52. We, thus, are persuaded that a person of ordinary skill in the art would have been motivated to modify Aizawa as proposed, and would have had a reasonable expectation of success in doing so. The evidence of record adequately demonstrates that a skilled artisan would have appreciated that adding a convex cover, such as that taught by Ohsaki, would have improved adhesion between a sensor, such as that of Aizawa, and a user's skin, thus aiding in the prevention of slippage of the sensor device on the user's skin.

Accordingly, we conclude that the record adequately supports Petitioner's contentions by a preponderance of the evidence that claims 1–15, 17, 20–26, and 28 would have been obvious in view of Aizawa, Inokawa, and Ohsaki.

F. Obviousness over Aizawa, Inokawa, Mendelson-2006, and Beyer

Petitioner contends that claims 18, 19, 29, and 30 are unpatentable based on Aizawa, Inokawa, Mendelson-2006, and Beyer. Pet. 46–55. Claim 18 depends from claim 7 and includes features directed to a processor that is configured to receive signals indicative of a physiological parameter of a wearer and output information of those parameters to a mobile phone. Ex. 1001, 46:1–10. Claim 19 depends from claim 18 and adds the requirement of a "touch-screen display." *Id.* at 46:10–11. Claim 29 depends from claim 20 and adds a processor features similar to that set forth in

claim 18. *Id.* at 47:1–5. Claim 30 depends from claim 29 and adds the feature of a touch-screen display. *Id.* at 47:6–7.

1. *Overview of Mendelson-2006 (Ex. 1016)*

Mendelson-2006 is a journal article titled "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," and discloses a wireless wearable pulse oximeter connected to a personal digital assistant ("PDA"). Ex. 1016, 912.

Figure 1 of Mendelson-2006 is reproduced below.

Figure 1 illustrates a sensor module attached to the skin (top), and a photograph of a disassembled sensor module and receiver module (bottom). The sensor module includes an optical transducer, a stack of round printed circuit boards, and a coin cell battery. *Id.* at 913.

Figure 2 of Mendelson-2006 is reproduced below.

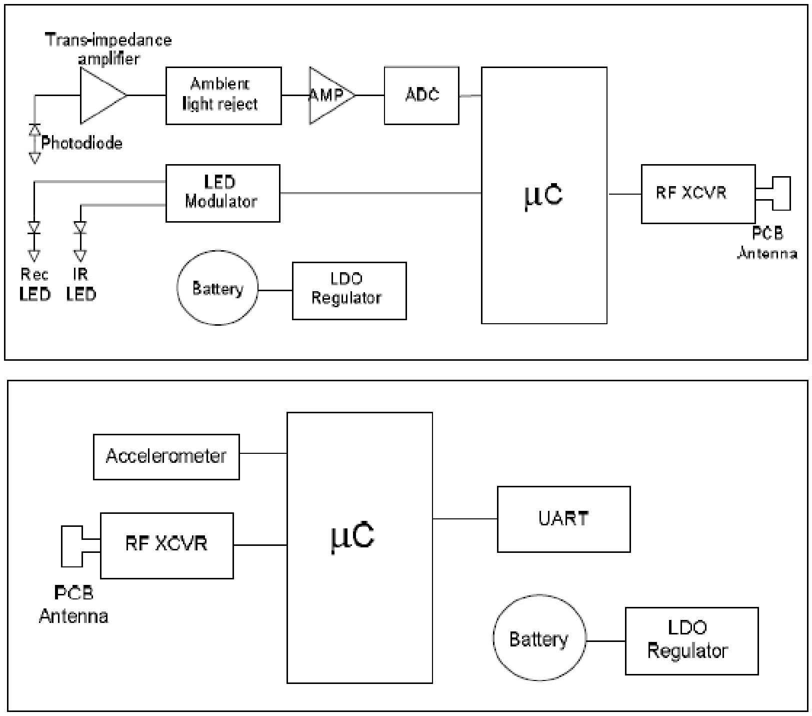


Figure 2 depicts a system block diagram of the wearable, wireless, pulse oximeter including the sensor module (top) and the receiver module (bottom). *Id.* The sensor module includes at least one light-emitting diode ("LED"), a photodetector, signal processing circuitry, an embedded microcontroller, and an RF transceiver. *Id.* at 912–913. Mendelson-2006 discloses that a concentric array of discrete photodetectors could be used to increase the amount of backscattered light detected by a reflectance type pulse oximeter sensor. *Id.* at 915. The receiver module includes an embedded microcontroller, an RF transceiver for communicating with the sensor module, and a wireless module for communicating with the PDA. *Id.* at 913.

As a PDA for use with the system, Mendelson-2006 discloses choosing "the HP iPAQ h4150 PDA because it can support both 802.11b

and Bluetooth™ wireless communication" and "has sufficient computational resources." *Id.* at 914. Mendelson-2006 further discloses that

> [t]he use of a PDA as a local terminal also provides a low-cost touch screen interface. The user-friendly touch screen of the PDA offers additional flexibility. It enables multiple controls to occupy the same physical space and the controls appear only when needed. Additionally, a touch screen reduces development cost and time, because no external hardware is required. . . . The PDA can also serve to temporarily store vital medical information received from the wearable unit.

Id.

The PDA is shown in Figure 3 of Mendelson-2006, reproduced below.

Figure 3 illustrates a sample PDA and its graphical user interface ("GUI"). *Id.* Mendelson-2006 explains that the GUI allows the user to interact with the wearable system. *Id.* "The GUI was configured to present the input and output information to the user and allows easy activation of various functions." *Id.* "The GUI also displays the subject's vital signs, activity level, body orientation, and a scrollable PPG waveform that is transmitted by

the wearable device." *Id.* For example, the GUI displays numerical oxygen saturation ("SpO_2") and heart rate ("HR") values. *Id.*

2. *Overview of Beyer (Ex. 1019)*

Beyer is titled "Cellular Phone/PDA Communication System" and discloses a "cellular PDA communication system for allowing a plurality of cellular phone users to monitor each others' location and status." Ex. 1019, codes (54), (57). Beyer's Figure 1 is reproduced below:

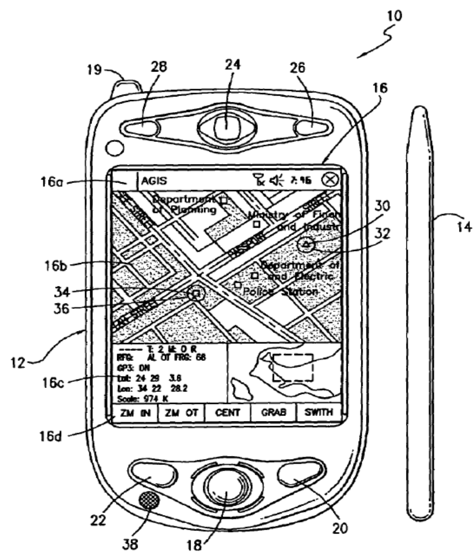


FIG. 1

Figure 1 shows a plan view of "handheld cellular phone/PDA communications system" 10. *Id.* at 7:17–19. System 10 includes touch display screen 16. *Id.* at 7:27.

3. *Discussion*

With support from the testimony of Dr. Kenny, Petitioner contends that each of claims 18, 19, 29, and 30 is unpatentable based on Aizawa, Inokawa, Mendelson-2006, and Beyer. Pet. 53–55 (citing Ex. 1003 ¶¶ 68–71, 147–154; Ex. 1006, ¶¶ 215, 23, 35; Ex. 1008 ¶ 56; Ex. 1016, 912–914,

Fig. 1; Ex. 1019, 1:6–15, 3:29–33; Ex. 1003 ¶¶ 68–70, 147–154). For instance, Petitioner applies the teachings of Mendelson-2006 and Beyer to account for the processor features required by each of claims 18 and 29 and the touch-screen display recited in claims 19 and 30. *Id.*

Patent Owner does not separately address this ground urging only that the ground "does not fix the deficiencies" that were alleged in connection with the ground based on Aizawa and Inokawa. PO Resp. 45. As discussed above, we do not agree with Patent Owner as to any such deficiencies. *See supra* § II.D. We have reviewed the Petition and its supporting evidence and conclude that Petitioner has shown by a preponderance of the evidence that claims 18, 19, 29, and 30 are unpatentable based on Aizawa, Inokawa, Mendelson-2006, and Beyer.

G. Obviousness over Aizawa, Inokawa, Goldsmith, and Lo

Petitioner argues that claims 18, 19, 29, and 30 of the '628 patent would have been obvious over Aizawa, Inokawa, Goldsmith, and Lo. Pet. 2, 57–62. Because we have already determined that those claims are unpatentable based on Aizawa, Inokawa, Mendelson-2006, and Beyer, we need not reach this additional ground applied to those claims. *See Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App'x 984, 990 (Fed. Cir. 2020) ("[T]he Board need not address issues that are not necessary to the resolution of the proceeding.").

H. Obviousness over Mendelson-1988 and Inokawa

Petitioner contends that claims 1–17 and 20–28 are unpatentable over Mendelson-1988 and Inokawa. Pet. 62–87. Patent Owner disagrees. PO Resp. 45–59. We conclude that a preponderance of the evidence supports

Petitioner's assertions that claims 1–17 and 20–28 are unpatentable based on Mendelson-1988 and Inokawa.

1. Overview of Mendelson-1988 (Ex. 1015)

Mendelson-1988 discloses a pulse oximeter, with an optical reflectance sensor suitable for noninvasive monitoring of a user's arterial hemoglobin oxygen saturation (SpO_2), via the user's forehead. *See* Ex. 1015, 167 (title & abstract). Figure 2 is reproduced below:

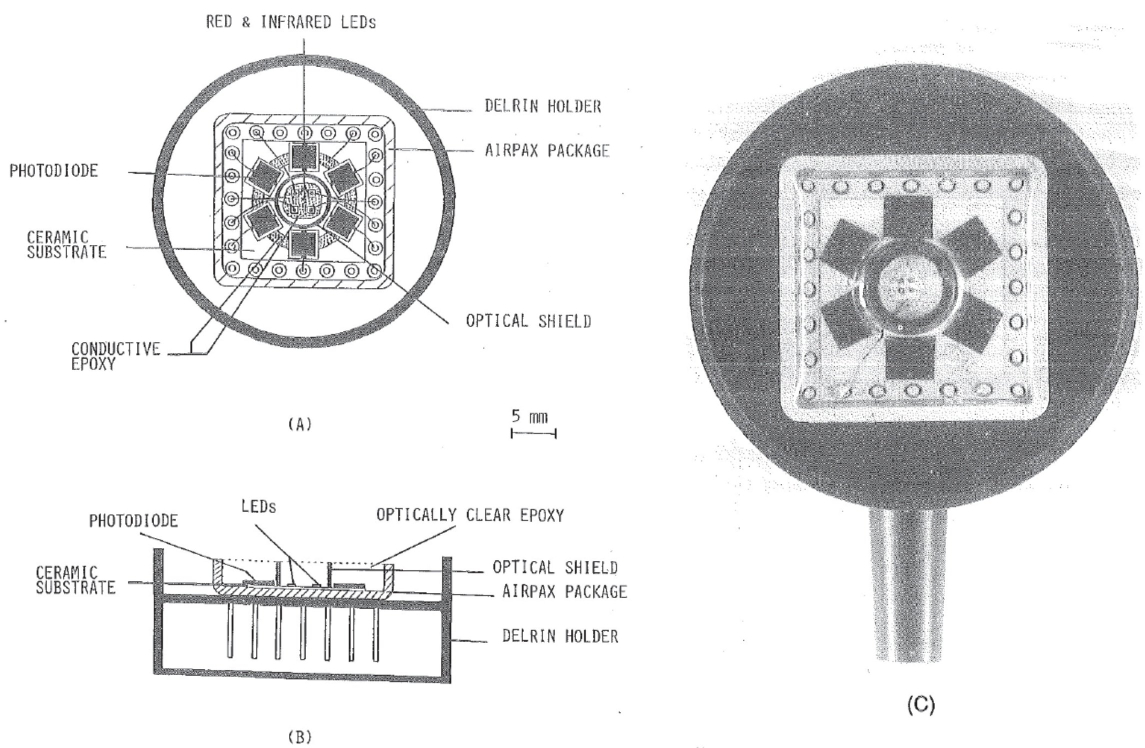


Figure 2 illustrates the sensor of Mendelson-1988, including: (A) a top view diagram; (B) a side view diagram; and (C) a photograph. *Id.* at 169.

The sensor includes two red LEDs and two infrared LEDs for emitting light into the user's tissue, and six photodiodes "arranged symmetrically in a hexagonal configuration" surrounding the four emitters, to detect light reflected back to the sensor from the user's tissue. *Id.* at 168 ("SENSOR DESIGN"). The user's "SpO_2 can be calculated from the ratio of the

reflected red and infrared photoplethysmograms." *Id.* at 167. "To minimize the amount of light transmission and reflection between the LEDs and the photodiodes within the sensor, a ring-shaped, optically opaque shield of black Delrin . . . was placed between the LEDs and the photodiode chips." *Id.* at 168 (col. 2). "The optical components were encapsulated inside the package using optically clear adhesive." *Id.* "The microelectronic package was mounted inside a black Delrin housing." *Id.*

2. Claim 1

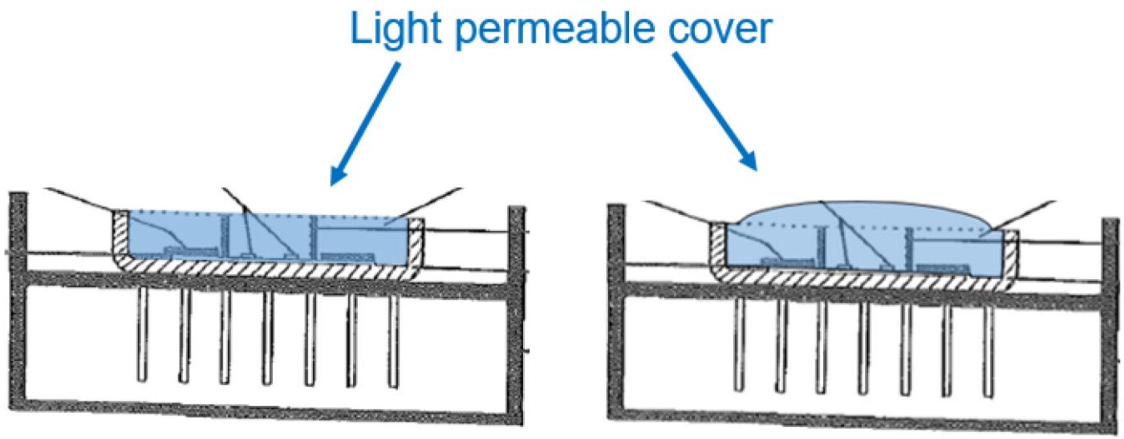
Petitioner provides arguments and evidence, including testimony from Dr. Kenny, in support of its view that claim 1 would have been obvious over Mendelson-1988 and Inokawa. Pet. 62–72; Ex. 1003 ¶¶ 174–183. In opposition, Patent Owner provides arguments and evidence, including testimony from Dr. Madisetti. PO Resp. 45–59; Ex. 2004 ¶¶ 118–125, 201–202.

i. Petitioner's Contentions

Petitioner contends that Mendelson-1988's SpO_2 sensor discloses each and every limitation of claim 1, except that its light permeable cover (i.e., the "OPTICALLY CLEAR EPOXY" in Figure 2B) lacks the claimed "protruding convex surface." *See* Pet. 67–73; Ex. 1003 ¶¶ 171–186. Petitioner also contends Inokawa's pulse sensor 1 is a noninvasive optical measurement device having a light permeable cover (i.e., lens 27) comprising a convex protrusion arranged to cover its light detector(s) (i.e., detector 25). Pet. 70. Petitioner reasons that an ordinarily skilled artisan would have been motivated, with a reasonable expectation of success, to modify Mendelson-1988's optical SpO_2 sensor, in light of Inokawa's optical

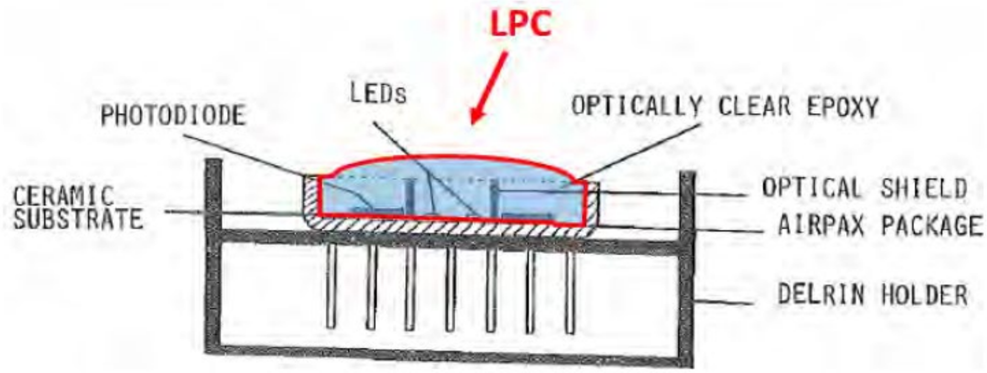
pulse sensor, by adding a convex protrusion to Mendelson-1988's cover to improve the sensor's light detection efficiency. *Id.* at 65–67.

Dr. Kenny provides the following illustrations to portray the proposed modification of Mendelson-1988's sensor (Ex. 1003 ¶¶ 179–180):

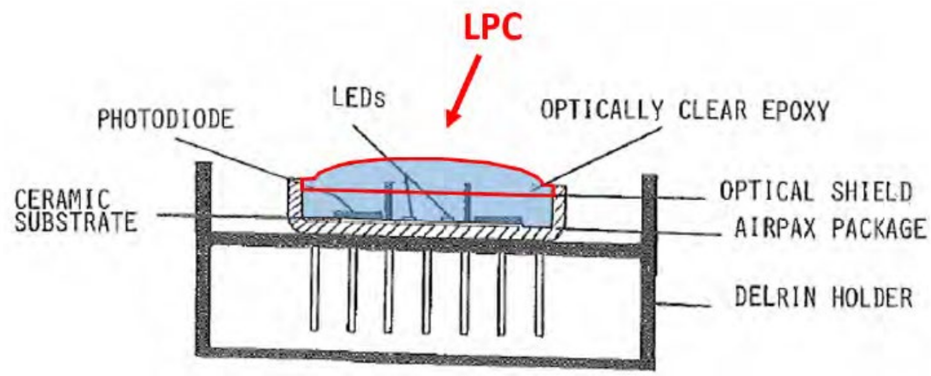


At the left, Dr. Kenny has excerpted and annotated Mendelson-1988's Figure 2B, to identify the pre-existing cover (colored blue) which covers the light emitters and detectors. *See id.* At the right, Dr. Kenny has illustrated the device resulting from the proposed modification of the cover to have a convex protrusion (colored blue). *See id.*

Petitioner further asserts "there are two alternative ways of mapping the claimed 'light permeable cover,' or LPC, to the modified cover above." Pet. 70; Ex. 1003 ¶¶ 184–185. Dr. Kenny provides the following two illustrations, annotating Mendelson-1988's Figure 2B, to identify these alternative mappings:



APPLE-1015, FIG. 2(B)



APPLE-1015, FIG. 2(B).

Dr. Kenny's first mapping (top figure) equates the cover to the entire depth of the epoxy contained within the AIRPAX package as shown in red outline. Ex. 1003 ¶ 184. Dr. Kenny's second mapping (bottom figure) equates the cover to a partial depth of the epoxy within the package as shown in red outline. *Id.* ¶ 185 ("a [person of ordinary skill in the art] would have been able to use the top portion of the housing, as in Nishikawa, to help form the LPC portion on top of the sealing portion.")

Petitioner adds that "a [person of ordinary skill in the art] would have realized that the epoxy layer could have been given a shape that would help further advance Mendelson-1988's objective of improving detection efficiency," "requir[ing] only routine knowledge of sensor design and

assembly." Pet. 64, 66 (citing Ex. 1015, 168, 173); Ex. 1003 ¶¶ 176, 181–182. For example, "as demonstrated by Nishikawa, molding clear epoxy, as in Mendelson-1988, into a lens shape was well understood." Pet. 66 (citing Ex. 1023, Fig. 6, ¶¶ 22, 32, 35, 37).

ii. Patent Owner's Contentions

Patent Owner is of the view that Petitioner has not met its burden to demonstrate the obviousness of modifying Mendelson-1988's sensor in light of Inokawa to have a convex protrusion, based on substantially the same analysis and testimony discussed above in the context of combining Aizawa and Inokawa. *See* PO Resp. 47–50; Ex. 2004 ¶¶ 104–110; *supra* Section II.D.3. For example, Mendelson-1988, like Aizawa, provides a central emitter or emitters surrounded by several detectors. *Compare* Ex. 1015, 169 (Fig. 2) (showing four central LEDs surrounded by six photodiodes), *with* Ex. 1006, Figs. 1(a)–1(b) (showing one central LED 21 surrounded by four photodetectors 22).

Patent Owner also objects to Petitioner's alternative mapping, providing for a cover with a protrusion to be found in two different ways. *See* PO Resp. 50–54; Ex. 2004 ¶¶ 113–117. This alternative mapping, in according to Patent Owner, is "ambiguous[]," and the second mapping incorporates an "arbitrary" drawn line defining the bottom of the cover in "an ***undifferentiated*** mass of material." PO Resp. 53–54. Patent Owner also argues that "Petitioner's inability to consistently identify a 'cover' reveals the hindsight-driven nature of its arguments." *Id.* at 53.

As with the ground based on Aizawa and Inokawa, Patent Owner here additionally is of the view that Petitioner errs in referencing Nishikawa as supporting the unpatentability of claim 1, because Nishikawa is not

identified as part of Ground 2A which instead "includes only two references" Mendelson-1988 and Inokawa. PO Resp. 56–57 (citing Pet. 2, 66, 71–72, 80; Ex. 2007, 364:2–13; Ex. 2008, 73:8–12; Ex. 2004 ¶¶ 122–123). Patent Owner further asserts that Petitioner's reliance on Nishikawa "makes no sense" based on substantially the same analysis and testimony discussed above in the context of combining Aizawa and Inokawa. *Id.* at 57. Patent Owner similarly takes issue with another prior art reference that is addressed to some extent by Petitioner and Dr. Kenny, namely Mendelson '799.[12] *Id.* at 57–58. Patent Owner argues that Petitioner improperly relies on both Nishikawa and Mendelson '799 "to fill missing gaps [in Mendelson-1988 and Inokawa], not as evidence of general knowledge in the art," thereby attempting to "sidestep the requirements to establish a motivation and expectation of success." *Id.* at 58 (citing Pet. 70; *K/S HIMPP v. Hear-Wear Technologies, LLC*, 751 F.3d 1362, 1366 (Fed. Cir. 2014)); Ex. 2004 ¶ 125.

With respect to claim 7, Patent Owner also contends that "Mendelson-1988 and Inokawa also fail to include a ***circular*** housing with a light permeable cover[.]" PO Resp. 54. Patent Owner characterizes the optical components of each of Mendelon-1988 and Inokawa as being square in shape, and discounts Petitioner's reasoning that one of ordinary skill in the art "would have recognized that microelectronic packaging as used in Mendelon-1988 comes in various shapes and sizes." *Id.* at 55 (quoting Pet. 80). Patent Owner further characterizes Petitioner's and Dr. Kenny's

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[12] U.S. Patent No. 6,801,799 B2 issued October 5, 2004 (Ex. 1025) ("Mendelson '799").

testimony that "using a circular housing having a circular wall . . . was common practice" as conclusory. *Id.* at 56 (quoting Pet. 80).

iii. Petitioner's Reply

In its Reply, Petitioner provides similar analysis and testimony as that discussed above in the context of combining Aizawa and Inokawa. *See* Pet. Reply 27 (citing Pet. 63–65; Ex. 1047 ¶ 54). Specifically, Petitioner contends that an ordinarily skilled artisan would have been motivated, with a reasonable expectation of success, to modify Mendelson-1988 based on Inokawa's teachings to add a lens. *Id.* Petitioner also maintains that the Petition and Dr. Kenny's supporting testimony adequately account for the "cover" required by the claims of the '628 patent, including the "alternative mapping" configuration. *Id.* at 28–30 (citing Pet. 71–72; Ex. 1003 ¶ 185; Ex. 1047 ¶¶ 57–60; Ex. 1009, 395:22–396:8, 396:9–17). Petitioner additionally argues that the Petition accounts for claim 7's requirement of a circular housing based on the teachings of Mendelson-1988 and Inokawa. Pet. Reply 30–31. Petitioner further submits that Dr. Kenny's reference to other prior art references as a part of his testimony, and specifically Nishikawa, is not improper as such reference "provides further support for the actual combination (*i.e.*, Mendelson-1988 in view of Inokawa) by demonstrating how the lens of Inokawa may be incorporated in a manufacturing context." Pet. Reply 31–32 (citing Ex. 1003 ¶¶ 96, 182; Ex. 1047 ¶ 62; Ex. 2007, 364:2–13).

iv. Patent Owner's Sur-reply

Patent Owner's Sur-reply generally reiterates its arguments challenging Petitioner's contentions as to the obviousness of modifying

Mendelon-1988's sensor to include a convex protrusion. *See* Sur-reply 21–25.

v. Discussion

Petitioner contentions that Mendelson-1988's sensor meets several limitations of claim 1 are not challenged by Patent Owner. We agree. For instance, we are persuaded by Petitioner as to the following. The sensor is a noninvasive optical measurement device adapted to be worn on a user's forehead, to provide an indication of a physiological parameter of the user (i.e., SpO_2).[13] *See* Ex. 1015, 167 (abstract); Pet. 67; Ex. 1003 ¶ 171. The sensor has two infrared LED chips and two red LED chips, i.e., a plurality of emitters. *See* Ex. 1015, 168 (col. 2) ("The optical reflectance sensor used in this study consists of two red (peak emission wavelength: 660 nm) and two infrared (peak emission wavelength: 930 nm) LED chips"), 169 (Fig. 2A); Pet. 67–68; Ex. 1003 ¶ 172. The sensor further includes at least four detectors (i.e., the six photodiodes) arranged on a housing's surface and spaced apart from each other, symmetrically on a circle centered on the four LEDs. *See* Ex. 1015, 168 (col. 2) (stating the six photodiodes are "arranged symmetrically in a hexagonal configuration"), 169 (Fig. 2); Pet. 75–76; Ex. 1003 ¶ 173. The six photodiodes are configured to output signals responsive to light emitted from the four emitters and attenuated by the user's body tissue, with the signals being indicative of the user's SpO_2. *See* Ex. 1015, 167 (col. 2) ("SpO_2 can be calculated from the ratio of the

[13] Whether the preamble is limiting need not be resolved, because the recitation in the preamble is satisfied by the prior art.

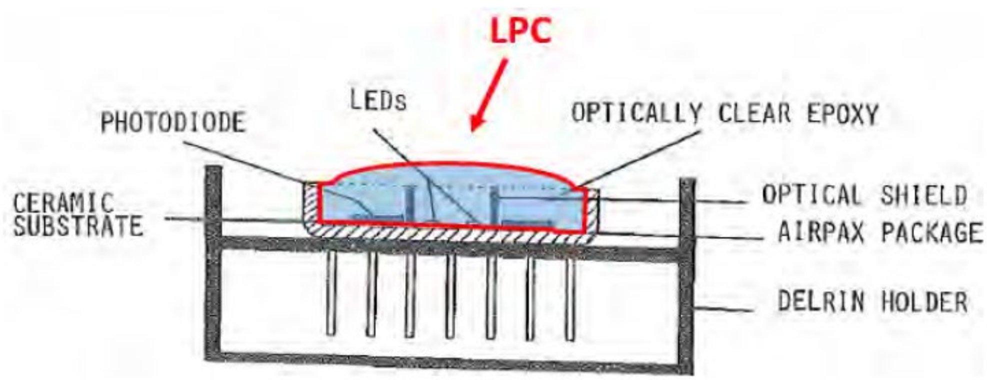
reflected red and infrared photoplethysmograms."); Pet. 75–76; Ex. 1003 ¶ 171.

We also find that a preponderance of the evidence establishes that the Mendelson-1988 sensor's optically clear epoxy is a light permeable cover that covers the sensor's six detectors. In particular, it is clear from Figures 2A and 2B that the epoxy extends from the top of the sensor at the dotted line in the figure, down into the well of the AIRPAX package, to cover all four LEDs and all six photodiodes disposed at the bottom of the well. *See also* Ex. 1015, 168 (col. 2) ("The optical components were encapsulated inside the package using optically clear adhesive"). Although Patent Owner disagrees, that disagreement is premised on its proposed claim construction of the term "cover" as excluding resins and epoxies. *See* PO Resp. 50–51. For reasons provided in Section III.C.1 above, we do not find that claim construction persuasive, and Patent Owner does not distinguish Mendelson-1988 from claim 1 on this basis.

We determine that Petitioner has established persuasively that Mendelson-1988's sensor teaches every limitation of claim 1, with the exception that its light permeable cover has a flat surface and, thus, does not include an "outwardly protruding convex surface." We, however, conclude that a preponderance of the evidence supports Petitioner's contention that it would have been obvious to modify the top surface of Mendelson-1988's cover to include a convex protrusion, in order to increase the amount of backscattered light that will be received by the six peripheral detectors. Our reasoning is substantially identical to the analysis provided above in connection with the ground based on Aizawa and Inokawa, with Mendelson-1988 replacing Aizawa in the combination. *See supra*

Section III.D.3. Patent Owner does not cite, and we do not discern, any material difference between Mendelson-1988 and Aizawa that might lead to a different result here, with one possible exception.

That difference is Petitioner's alternative mapping of the claimed "cover" to Petitioner's proposed modification of Mendelson-1988's sensor. We rely on the first mapping, but not Petitioner's second mapping, to decide in Petitioner's favor. Petitioner's first mapping is again reproduced here (Ex. 1003 ¶ 184):



APPLE-1015, FIG. 2(B)

In this modified and annotated version of Figure 2B of Mendelson-1988, Dr. Kenny identifies how Mendelson-1988's light permeable cover ("LPC") may be modified to have a protrusion, wherein the cover (which Dr. Kenny has colored blue) includes the entire depth of the optically clear epoxy contained within the AIRPAX package (as Dr. Kenny has shown in red outline). *Id.* ¶ 140; Pet. 71. Patent Owner objects to this mapping as ambiguous, but we determine Dr. Kenny's annotations reproduced above are sufficiently clear to establish obviousness by a preponderance of the evidence.

As with the ground based on Aizawa and Inokawa, Patent Owner argues that the ground based on Mendelson-1988 and Inokawa is flawed

because of the Petition's and Dr. Kenny's reference to Nishikawa. For the same reasons discussed above (*see supra* § II.D.3.iv.(5)) we find that argument unavailing.

vi. Summary

For the foregoing reasons, we conclude that Petitioner has demonstrated by a preponderance of the evidence that claim 1 is unpatentable as having been obvious over Mendelson-1988 and Inokawa.

3. Claim 7

Claim 7 is similar to claim 1 but includes an additional requirement that the light permeable cover has a "circular housing including a planar surface." Ex. 1001, 45:13. Petitioner provides arguments and evidence, including testimony from Dr. Kenny, in support of the contention that independent claim 7 would have been obvious over Mendelson-1988 and Inokawa. Pet. 79–82; Ex. 1003 ¶¶ 198–205. Much of Petitioner's analysis for claim 7 applies for claim 1, which as discussed above in Section II.H.2 we find persuasive.

With respect to the "circular housing having a planar surface" requirement, Petitioner points to Mendelson's Figures 2(A) and 2(B) and contends that "Mendelson-1988 discloses that its LEDs and photodiode chips (i.e., emitters and detectors) are mounted on a ceramic substrate (***planar surface***) and housed within an AIRPAX microelectronic package (***housing***)." Pet. 79. Petitioner, however, characterizes the housing shown in those figures, specifically Figure 2(A) as "appear[ing] to have a square shape, not a circular one." *Id.* at 80. Petitioner reasons that "[a person of ordinary skill in the art] would have recognized that microelectronic

packaging as used in Mendelson-1988 comes in various shapes and sizes" and "[a person of ordinary skill in the art] would have considered using a differently shaped housing, namely a circular one, to be obvious." *Id.* (citing Ex. 1003 ¶ 202). Petitioner also contends that employing a circular housing was "common practice" prior to the '628 patent, and that "there was nothing new or inventive about changing one housing shape for another. *Id.* (citing Ex. 1003 ¶ 202). Petitioner explains that its contentions are evidenced by another reference of record, Mendelson '799. *Id.*

Patent Owner characterizes Petitioner's proposed ground for claim 7 as "facially deficient" for several reasons: (1) "Petitioner never identifies a motivation to pick a circular-shaped housing instead of the existing square shape"; (2) "[a person of ordinary skill in the art] would have no particular motivation to change the shape unless a [person of ordinary skill in the art] perceived some benefit in doing so"; (3) "Mendelson '799 does not disclose a cover (or even epoxy encapsulation) and thus cannot disclose a circular housing and a cover of the circular housing, as claim 7 requires"; and (4) "Petitioner did not include Mendelson '799 in any ground." PO Resp. 55–56 (citing Ex. 2004 ¶¶ 120–121).

In response to Patent Owner's arguments, Petitioner replies that "references like Mendelson [']799 have a circular wall/housing and confirm the notion that a [person of ordinary skill in the art] would have found it to be simply a matter of design choice to use different shapes." Pet. Reply 30–31 (citing Ex. 1003 ¶ 201; Ex. 1025, Fig. 7, 9:34–36; Ex. 1047 ¶ 61). Petitioner also contends "neither the '628 patent nor [Patent Owner] provides any explanation of how the particular housing shape solves some

problem or presents some unexpected result." *Id.* at 31 (citing *In re Kuhle*, 526 F.2d 553, 555 (CCPA 1975)).

Patent Owner responds that "Petitioner's reply reiterates its conclusory arguments that [the proposed] change would be routine, without identifying any reason to modify the shape from square to circular." Sur-reply 24.

On the record before us, we conclude that a preponderance of the evidence supports Petitioner's contention that it would have been obvious to modify the shape of Mendelson-1988's AIRPAX package from square to circular. Petitioner's and Dr. Kenny's general assessment that a person of ordinary skill in the art would have been aware that a circular housing shape was a known option for housing of components of a physiological sensor finds support in the record. Pet. 79–80; Ex. 1003 ¶ 201. In that respect, although Mendelson '799 was not listed in the styling of the proposed grounds of unpatentability based on Mendelson-1988 and Inokawa, its teachings plainly were offered in the Petition as evidence of the background knowledge that an ordinarily skilled artisan would have brought to bear in an evaluation of the teachings Mendelson-1988 and Inokawa. Pet. 79–80. Moreover, it is clear that Patent Owner understood that the proposed ground offered in the Petition took into account the disclosure of Mendelson '799, and Patent Owner had opportunity to address that disclosure. Indeed, Patent Owner availed itself of that opportunity during trial (*see, e.g.*, PO Resp. 54–56; Sur-reply 24).

We further find unavailing Patent Owner's argument that "Mendelson '799 does not disclose a cover (or even epoxy encapsulation) and thus cannot disclose a circular housing and a cover of the circular housing, as

claim 7 requires." PO Resp. 56. Figure 7 of Mendelson '799 is reproduced below:

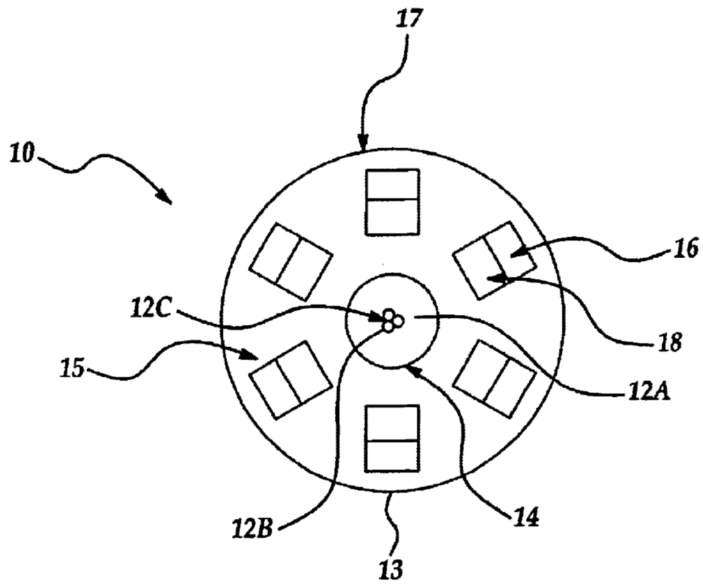


Figure 7

Figure 7 is a top view of optical sensor 10 comprising light source 12 composed of three LEDs 12A, 12B, and 12C emitting light of three different wavelengths, and an array of six near detectors 18 and six far detectors 16 "arranged in two concentric ring-like arrangements" surrounding light source 12. Ex. 1025, 9:23–34. "All these elements are accommodated in a sensor housing 17" which, as can be seen in Figure 7, is clearly circular. *Id.* at 9:34–35. Patent Owner does not articulate why the presence or absence of a cover in Mendelson '799 somehow serves to discount Mendelson '799's unambiguous presentation of a sensor housing having a shape recognizable as circular.

Furthermore, one of ordinary skill in the art would have understood that the AIRPAX package of Mendelson-1988 and the housing 17 of Mendelson '799 are performing the same function of enclosing a central collection of light emitters which are surrounded by an array of light

detectors in an optical sensor attached to a user's body. *See, e.g.*, Ex. 1015, Figs. 2A–2B; Ex. 1025, Fig. 7. The evidence of record also does not suggest that the shape of such a housing has any functional significance in the operation of the optical sensor, or that any particular known shape was preferred or restricted. Thus, the evidence suggests that a square shape and a circular shape of such as housing were known in the art to be predictable substitutes for one another, and therefore obvious variants. *See, e.g.*, *KSR*, 550 U.S. at 416 ("[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result."); *id.* at 417 ("[W]hen a patent 'simply arranges old elements with each performing the same function it had been known to perform' and yields no more than one would expect from such an arrangement, the combination is obvious." (citation omitted)).

We conclude Petitioner has demonstrated by a preponderance of the evidence that Petitioner's ground based on Mendelson-1988 and Inokawa conveys the unpatentability of claim 7.

4. Claims 2–6, 8–17, and 20–28

Petitioner provides argument and evidence, including testimony from Dr. Kenny, in support of its position that claims 2–6, 8–17, and 20–28 are unpatentable over Mendelson-1988 and Inokawa. Pet. 73–79, 82–87. Patent Owner does not advance any arguments for claims 2–6, 8–17, and 20–28, that are distinct from those provided for claims 1 and 7. *See* PO Resp. 59. For the same reasons set forth in Sections II.H.2 & 3 above, we find Patent Owner's arguments unavailing as to claims 2–6, 8–17, and 20–28. Having evaluated the Petition and its underlying supporting evidence, we conclude

that Petitioner has established by a preponderance of the evidence that claims 2–6, 8–17, and 20–28 are also unpatentable based on Mendelson-1988 and Inokawa.

I. Obviousness over Mendelson-1988, Inokawa, Mendelson-2006, and Beyer

Petitioner contends that claims 18, 19, 29, and 30 are unpatentable based on Mendelson-1988, Inokawa, Mendelson-2006, and Beyer. Petitioner relies on Mendelson-2006 and Beyer to satisfy the processor and touch-screen display requirements set forth in those claims. Pet. 87–93. Patent Owner does not dispute Petitioner's reliance on the teachings of Mendelson-2006 and Beyer. Rather, Patent Owner challenges this ground for the same reasons that were advanced for the ground based on Mendelson-1988 and Inokawa. PO Resp. 59. As discussed above (*see supra* § II.H), we find those arguments unavailing. Having reviewed the Petition and its underlying supporting evidence, we conclude that Petitioner has established by a preponderance of the evidence that claims 18, 19, 29, and 30 are unpatentable for obviousness based on Mendelson-1988, Inokawa, Mendelson-2006, and Beyer.

III. CONCLUSION

In summary, we determine that a preponderance of the evidence establishes claims 1–30 of the '628 patent are unpatentable, as shown in the following table:[14]

[14] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or*

Claim(s)	35 U.S.C. §	References	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–15, 17, 20–26, 28	103	Aizawa, Inokawa	1–15, 17, 20–26, 28	
1–15, 17, 20–26, 28	103	Aizawa, Inokawa, Ohsaki	1–15, 17, 20–26, 28	
18, 19, 29, 30	103	Aizawa, Inokawa, Mendelson-2006, Beyer	18, 19, 29, 30	
18, 19, 29, 30	103	Aizawa, Inokawa, Goldsmith, Lo[15]		
1–17, 20–28	103	Mendelson-1988, Inokawa	1–17, 20–28	
18, 19, 29, 30	103	Mendelson-1988, Inokawa, Mendelson-2006, Beyer	18, 19, 29, 30	
Overall Outcome			1–30	

Reexamination During a Pending AIA Trial Proceeding. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. §§ 42.8(a)(3), (b)(2).

[15] As explained above in Section II.G, because we conclude that claims 18, 19, 29, and 30 are unpatentable on other grounds, we do not reach the merits of this ground.

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–30 of the ’628 patent have been shown to be unpatentable; and

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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U.S. DEPARTMENT OF COMMERCE
UNITED STATES PATENT AND TRADEMARK OFFICE

May 23, 2022

THIS IS TO CERTIFY that the attached document is a list of the papers that comprise the record before the Patent Trial and Appeal Board (PTAB) for the *Inter Partes* Review proceeding identified below.

APPLE INC.,

Petitioner,

v.

MASIMO CORPORATION,

Patent Owner.

Case No.: IPR2020-01536
United States Patent No.: 10,588,553 B2

By authority of the
DIRECTOR OF THE UNITED STATES
PATENT AND TRADEMARK OFFICE

/s/ Mekbib Solomon
Certifying Officer

PROSECUTION HISTORY FOR *INTER PARTES* REVIEW NO.: IPR2020-01536

DATE	DESCRIPTION
08/31/2020	Petition for *Inter Partes* Review
08/31/2020	Petitioner's Power of Attorney
08/31/2020	Petitioner's Notice Ranking Petitions and Explaining Material Differences
09/17/2020	Notice of Filing Date Accorded
09/21/2020	Patent Owner's Mandatory Notices
11/04/2020	Petitioner's Updated Exhibit List
12/17/2020	Patent Owner's Notice of Waiver of Preliminary Response
03/02/2021	Decision - Institution of *Inter Partes* Review Proceeding
03/02/2021	Scheduling Order
03/16/2021	Patent Owner's Objections to Admissibility of Petitioner's Evidence Submitted Before Trial Institution
04/08/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
04/14/2021	Stipulation Modifying Due Dates
04/16/2021	Patent Owner's Motion for *Pro Hac Vice* Admission – Jeremiah Helm
04/16/2021	Patent Owner's Motion for *Pro Hac Vice* Admission – William Zimmerman
04/16/2021	Patent Owner's Updated Exhibit List
04/20/2021	Decision Granting Patent Owner's Motions for *Pro Hac Vice* Admission
04/20/2021	Patent Owner's Amended Notice of Deposition - Thomas W. Kenny
04/21/2021	Patent Owner's Updated Mandatory Notice
04/21/2021	Patent Owner's Supplemental Power of Attorney – W. Zimmerman and J. Helm
04/22/2021	Petitioner's Motion to Submit Supplemental Information
05/06/2021	Order Granting Petitioner's Motion to Submit Supplemental Information
05/14/2021	Petitioner's Submission of Supplemental Information
06/01/2021	Patent Owner's Response
06/08/2021	Petitioner's Objections to Evidence
07/19/2021	Petitioner's Notice of Deposition - Vijay K. Madisetti
08/24/2021	Petitioner's Reply to Patent Owner's Response
08/31/2021	Patent Owner's Objections to Evidence
09/09/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
09/13/2021	Petitioner's Updated Mandatory Notice
09/14/2021	Patent Owner's Updated Notice of Deposition - Thomas W. Kenny
10/05/2021	Patent Owner's Sur-Reply
10/13/2021	Petitioner's Objections to Evidence
10/22/2021	Petitioner's Request for Oral Hearing
10/22/2021	Patent Owner's Oral Argument Request
10/28/2021	Patent Owner's Supplemental Mandatory Notices
11/01/2021	Order Setting Oral Argument
11/22/2021	Petitioner's Identification of Testimony
12/03/2021	Patent Owner's Demonstratives for Trial Hearing

Date	Description
12/03/2021	Petitioner's Updated Exhibit List
01/06/2022	Oral Hearing Transcript
02/23/2022	Final Written Decision
04/12/2022	Notice of Appeal

Trials@uspto.gov
571-272-7822

Paper 43
Date: February 23, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

IPR2020-01536
Patent 10,588,553 B2

Before GEORGE R. HOSKINS, ROBERT L. KINDER, and AMANDA F. WIEKER, *Administrative Patent Judges.*

KINDER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

Apple Inc. ("Petitioner") filed a Petition requesting an *inter partes* review of claims 1–29 ("challenged claims") of U.S. Patent No. 10,588,553 B2 (Ex. 1001, "the '553 patent"). Paper 3 ("Pet."). Masimo Corporation ("Patent Owner") waived filing a Preliminary Response. Paper 8.

On March 2, 2021, we instituted trial. Paper 9 ("Inst. Dec." or "Decision to Institute"). Patent Owner filed a Response. Paper 24 ("PO Resp."). Petitioner filed a Reply. Paper 27 ("Pet. Reply"). Patent Owner filed a Sur-reply. Paper 32 ("Sur-reply"). An oral argument was held on December 7, 2021, and a transcript was entered into the record. Paper 42 ("Tr.").

We have jurisdiction to conduct this *inter partes* review under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons discussed herein, we determine that Petitioner has shown, by a preponderance of the evidence, that all challenged claims (claims 1–29) of the '553 patent are unpatentable.

B. Related Matters

The parties identify the following matters related to the '553 patent:

Masimo Corporation v. Apple Inc., Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

Apple Inc. v. Masimo Corporation, IPR2020-01537 (PTAB Aug. 31, 2020) (also challenging claims 1–29 of the '553 patent);

Apple Inc. v. Masimo Corporation, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2); and

Apple Inc. v. Masimo Corporation, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2).

Pet. 3–4; Paper 5, 3.

Patent Owner further identifies certain pending patent applications, as well as other issued and abandoned applications, that claim priority to, or share a priority claim with, the ’553 patent. Paper 5, 1–2.

C. The ’553 Patent

The ’553 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on March 17, 2020, from U.S. Patent Application No. 16/534,949, filed August 7, 2019. Ex. 1001, codes (21), (22), (45), (54). The ’553 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The ’553 patent relates to noninvasive methods and devices for measuring various blood constituents or analytes. *Id*. at code (57). The ’553

patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:38–40. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:29–35, 64–65. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:45–48.

Figure 1 of the '553 patent is reproduced below.

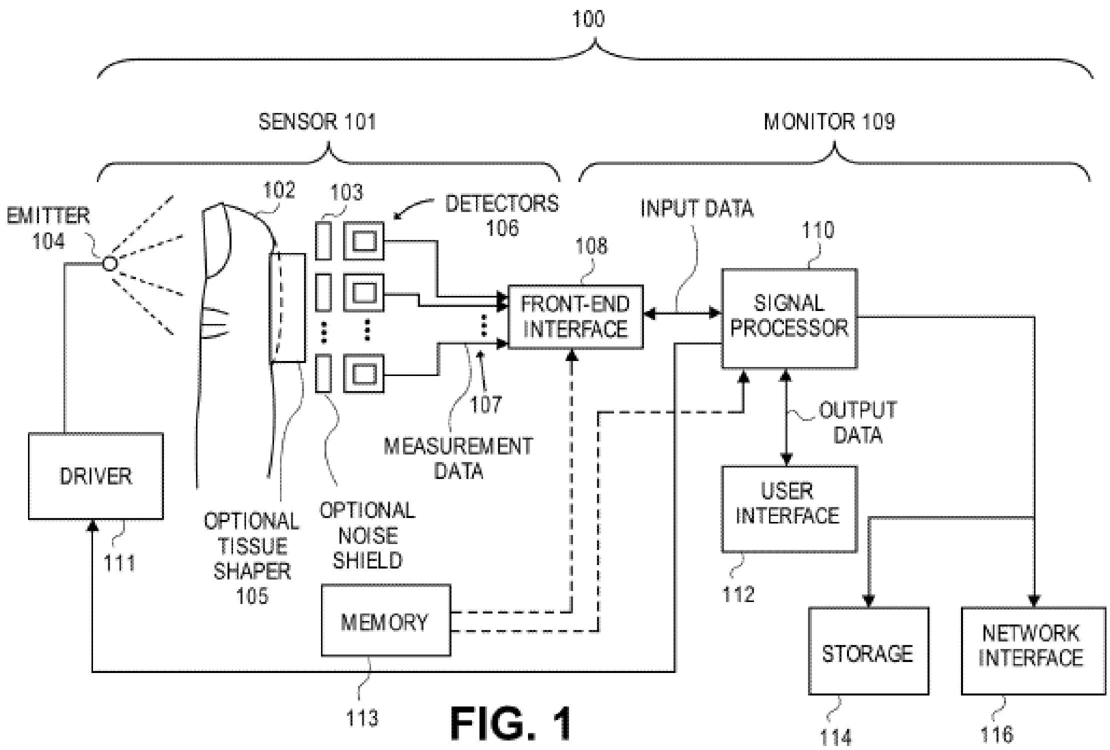


FIG. 1

Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:47–58. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* at 11:59–63. Emitters 104 emit light that is attenuated or reflected by the patient's tissue at measurement site 102. *Id.* at 14:3–7. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light,

detectors 106 output detector signals 107 to monitor 109 through front-end interface 108 and detectors 106 can be implemented using photodiodes. *Id.* at 14:7–10, 26–32. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 11:2–14.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:16–18. "[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals received from the detectors." *Id.* at 15:21–24. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:46–56. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 15:60–16:11.

The '553 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate sensor devices.

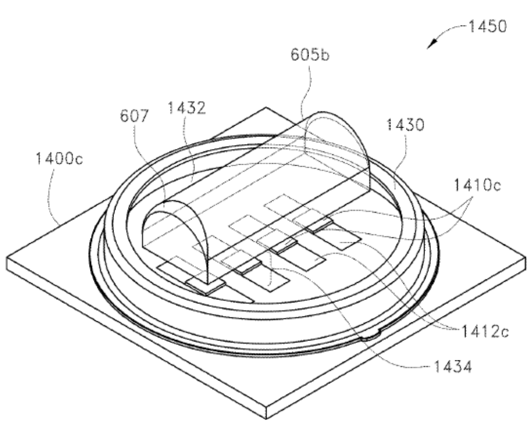


FIG. 14D

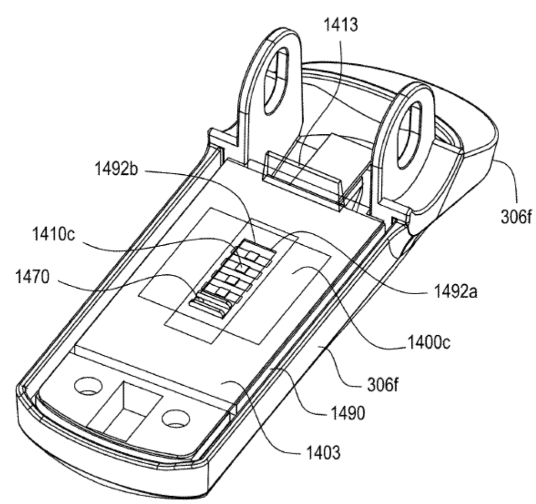


FIG. 14F

Figure 14D (left) illustrates portions of a detector submount and Figure 14F (right) illustrates portions of a detector shell. *Id.* at 6:44–47. As shown in

Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 35:36–39, 36:30–37. Figure 14F illustrates a detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 37:9–25. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* Alternatively, cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:47–48.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.

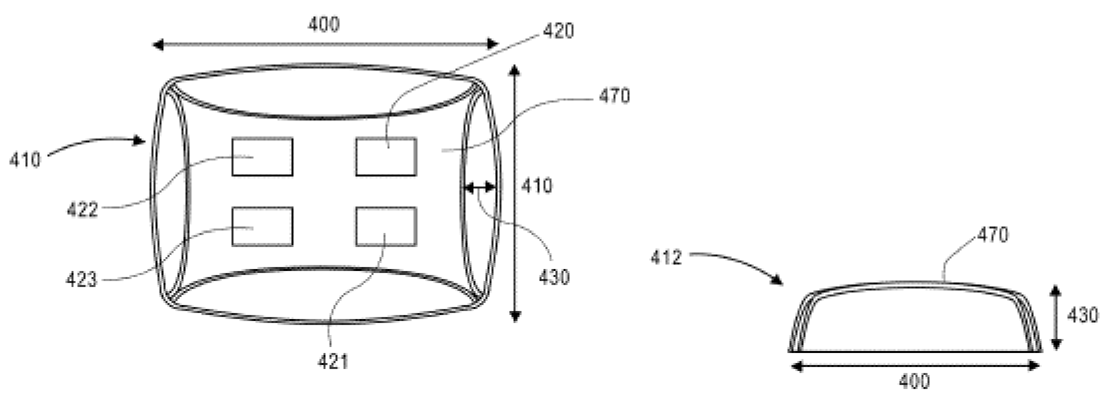


FIG. 4A FIG. 4B

Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:18–24. "[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site." *Id.* "For example, . . . measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site." *Id.* at 23:39–43. The measurement site contact area may include windows 420–423 that "mimic or approximately mimic a configuration of, or even house, a plurality of detectors." *Id.* at 23:49–63.

D. Illustrative Claim

Of the challenged claims, claims 1, 10, and 20 are independent. Claim 1 is illustrative and is reproduced below.

> 1. A noninvasive optical physiological sensor comprising:
>
> [a] a plurality of emitters configured to emit light into tissue of a user;
>
> [b] at least four detectors, wherein at least one of the at least four detectors is configured to detect light that has been attenuated by tissue of the user, and wherein the at least four detectors are arranged on a substrate;
>
> [c] a wall configured to circumscribe at least the at least four detectors; and
>
> [d] a cover configured to be located between tissue of the user and the at least four detectors when the noninvasive optical physiological sensor is worn by the user, wherein the cover comprises a single protruding convex surface operable to conform tissue of the user to at least a portion of the single protruding convex surface when the noninvasive optical physiological sensor is worn by the user, and wherein the wall operably connects to the substrate and the cover.

Ex. 1001, 44:50–67 (bracketed identifiers a–d added). Independent claims 10 and 20 include limitations substantially similar to limitations [a]–[d] of claim 1. *Id.* at 45:35–47, 46:22–46.

E. Applied References

Petitioner relies upon the following references:

Mendelson, U.S. Patent No. 6,801,799 B2, filed February 6, 2003, issued October 5, 2004 (Ex. 1012, "Mendelson-799");

Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1009, "Ohsaki");

Schulz et al., U.S. Patent Application Publication No. 2004/0054291 A1, filed July 31, 2003, published March 18, 2004 (Ex. 1013, "Schulz");

Griffin et al., U.S. Patent No. 7,658,613 B1, filed January 16, 2007, issued February 9, 2010 (Ex. 1014, "Griffin"); and

Y. Mendelson et al., "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," Proceedings of the 28th IEEE EMBS Annual International Conference, 912–915 (2006) (Ex. 1010, "Mendelson-2006").

Pet. 9.

Petitioner also submits, *inter alia*, the Declaration of Thomas W. Kenny, Ph.D. (Ex. 1003), as well as a Second Declaration of Dr. Kenny (Ex. 1047). Patent Owner relies, *inter alia*, on the Declaration of Vijay K. Madisetti, Ph.D. (Ex. 2004). The parties rely on numerous other exhibits and cross examination testimony as discussed below.

F. Asserted Grounds

Petitioner asserts that claims 1–29 are unpatentable based upon the following grounds:

Claim(s) Challenged	**35 U.S.C. §**	**References/Basis**
1–3, 5, 6, 9–18, 20–24, 29	103	Mendelson-799, Ohsaki
4, 18, 24	103	Mendelson-799, Ohsaki, Schulz
25	103	Mendelson-799, Ohsaki, Griffin
7, 19	103	Mendelson-799, Ohsaki, Mendelson-2006
8, 26–28	103	Mendelson-799, Ohsaki, Mendelson-2006, Griffin

II. DISCUSSION

A. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2019). Petitioner submits that no claim term requires express construction. Pet. 7–8. Patent Owner submits that claim terms should be given their ordinary and customary meaning, consistent with the Specification. PO Resp. 7.

Based on our analysis of the issues in dispute, we agree that no claim terms require express construction. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

B. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103 if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of non-obviousness.[1] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When

[1] Based on the final record, neither party introduced objective evidence of non-obviousness.

evaluating a combination of teachings, we must also "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of prior art elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

Petitioner identifies the appropriate level of skill in the art as that possessed by a person "hav[ing] a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information." Pet. 7 (citing Ex. 1003 ¶¶ 1–18, 20–21). "Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline." *Id.*

Patent Owner makes several observations regarding Petitioner's identified level of skill in the art but, "[f]or this proceeding, [Patent Owner] nonetheless applies Petitioner's asserted level of skill." PO Resp. 8.

We adopt Petitioner's assessment as set forth above, which is consistent with the level of skill reflected in the Specification and prior art.

D. Obviousness over the Combined Teachings of Mendelson-799 and Ohsaki

Petitioner contends that claims 1–3, 5, 6, 9–18, 20–24, and 29 of the '553 patent would have been obvious over the combined teachings of Mendelson-799 and Ohsaki. Pet. 10–62. Patent Owner disagrees and presents several arguments, including that the combination of Ohsaki and Mendelson-799 discloses "two different physiological monitor designs, with distinct shapes, features, and detector and emitter configurations." PO Resp. 9, 9–42; *see also generally* Sur-reply.

Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of the evidence that claims 1–3, 5, 6, 9–18, 20–24, and 29 are unpatentable.

1. Overview of Mendelson-799 (Ex. 1012)

Mendelson-799 is titled "Pulse Oximeter and Method of Operation," and discloses a sensor for non-invasive measurement of a blood parameter, which includes a sensor housing, a radiation source, and a detector. Ex. 1012, codes (54), (57).

Figure 7 of Mendelson-799 is reproduced below.

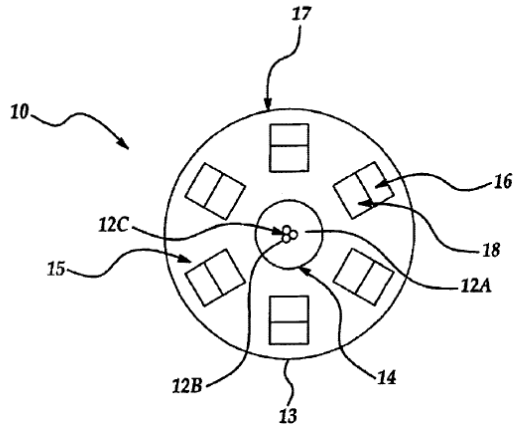


Figure 7

Figure 7 illustrates optical sensor 10 with light source 12, which includes three closely spaced light emitting elements 12a, 12b, 12c. *Id.* at 9:22–28. Optical sensor 10 includes an array of discrete detectors, i.e., "far" detectors 16 and "near" detectors 18, "arranged in two concentric ring-like arrangements . . . surrounding the light emitting elements." *Id.* at 9:29–34. "[L]ight shield 14 is positioned between the photodiodes and the light emitting elements, and prevents direct optical coupling between them, thereby maximizing the fraction of backscattered light passing through the arterially perfused vascular tissue in the detected light." *Id.* at 9:35–40. Sensor housing 17 accommodates the light source, light shield, and detectors. *Id.* at 9:34–35.

Figure 8 of Mendelson-799 is reproduced below.

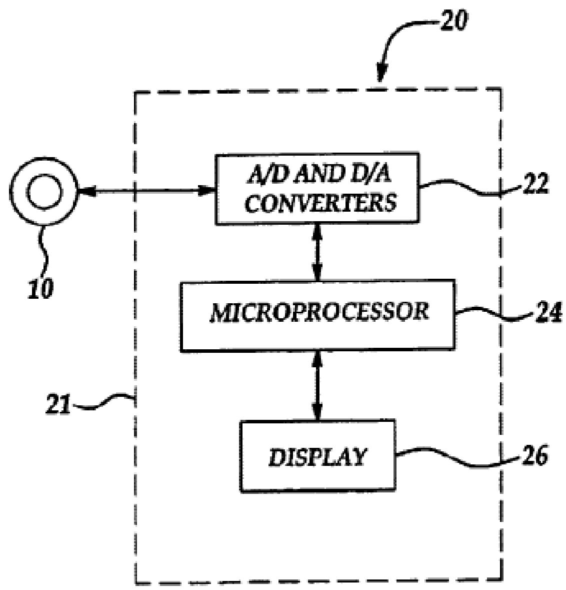


Figure 8

Figure 8 illustrates a block diagram of pulse oximeter 20 using sensor 10. *Id.* at 10:16–17. Pulse oximeter 20 includes control unit 21, with electronic block 22 connectable to sensor 10, microprocessor 24, and display 26, which presents measurement results. *Id.* at 10:17–22. "The measured data (i.e., electrical output of the sensor 10 indicative of the detected light) is directly processed in the block 22, and the converted signal is further processed by the microprocessor 24." *Id.* at 10:22–25.

2. Overview of Ohsaki (Ex. 1009)

Ohsaki is titled "Wristwatch-type Human Pulse Wave Sensor Attached on Back Side of User's Wrist," and discloses an optical sensor for detecting a pulse wave of a human body. Ex. 1009, code (54), ¶ 3.

Figure 1 of Ohsaki is reproduced below.

FIG. 1

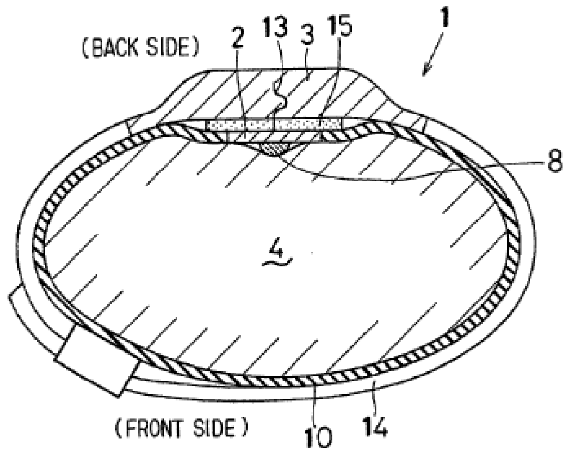


Figure 1 illustrates a cross-sectional view of pulse wave sensor 1 attached on the back side of user's wrist 4. *Id.* ¶¶ 12, 16. Pulse wave sensor 1 includes detecting element 2 and sensor body 3. *Id.* ¶ 16.

Figure 2 of Ohsaki, reproduced below, illustrates further detail of detecting element 2.

FIG. 2

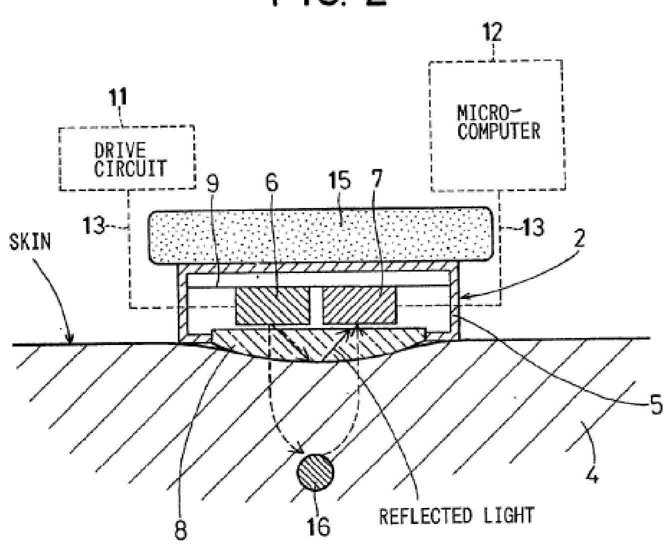


Figure 2 illustrates a mechanism for detecting a pulse wave. *Id.* ¶ 13. Detecting element 2 includes package 5, light emitting element 6, light

receiving element 7, and translucent board 8. *Id.* ¶ 17. Light emitting element 6 and light receiving element 7 are arranged on circuit board 9 inside package 5. *Id.* ¶¶ 17, 19.

"[T]ranslucent board 8 is a glass board which is transparent to light, and attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8." *Id.* ¶ 17. "[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin," preventing detecting element 2 from slipping off the detecting position of the user's wrist. *Id.* ¶ 25. By preventing the detecting element from moving, the convex surface suppresses "variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin." *Id.* Additionally, the convex surface prevents penetration by "noise such as disturbance light from the outside." *Id.*

Sensor body 3 is connected to detecting element 2 by signal line 13. *Id.* ¶ 20. Signal line 13 connects detecting element 2 to drive circuit 11, microcomputer 12, and a monitor display (not shown). *Id.* Drive circuit 11 drives light emitting element 6 to emit light toward wrist 4. *Id.* Detecting element 2 receives reflected light which is used by microcomputer 12 to calculate pulse rate. *Id.* "The monitor display shows the calculated pulse rate." *Id.*

3. Independent Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Mendelson-799 and Ohsaki. Pet. 10–42. Patent Owner presents several arguments, as examined below, as to why all claims in this ground would not have been obvious. *See* PO Resp. 9–43. Below,

we set forth how the limitations not disputed by Patent Owner are taught by the combination of references as argued by Petitioner. For those limitations and reasons for combining the references that are disputed, we first examine each of the parties' contentions and then provide our analysis.

i. "A noninvasive optical physiological sensor comprising"

Based on the final record, the cited evidence supports Petitioner's undisputed contention that the combination of Mendelson-799 and Ohsaki satisfies the subject matter of the preamble.[2] Pet. 30–31; *see, e.g.*, Ex. 1012, code (57) ("A sensor for use in an optical measurement device and a method for non-invasive measurement of a blood parameter."), 4:13–22, 7:25–8:41, 9:22–10:30, Fig. 7 (sensor device), Fig. 8; Ex. 1009, code (57), ¶¶ 3, 8, 15–17, 20, 25, Figs. 1, 2, 4A, 4B; Ex. 1003 ¶¶ 55–69, 78–98, 99–103.

ii. "[a] a plurality of emitters configured to emit light into tissue of a user"

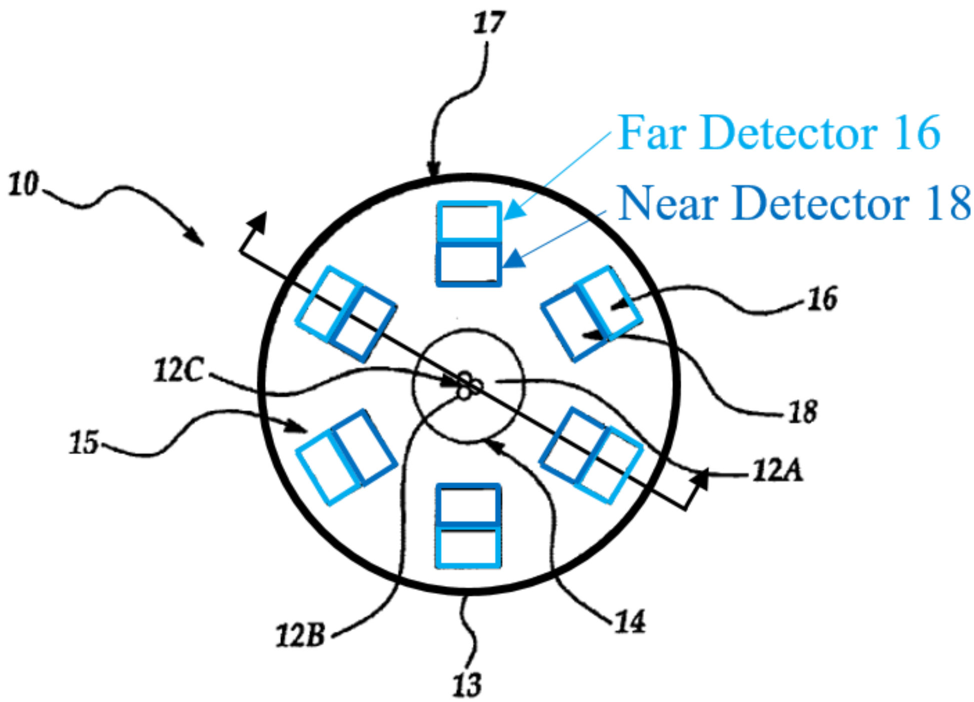
The cited evidence supports Petitioner's undisputed contention that Mendelson-799 discloses light emitting elements 12a, 12b, and 12c that emit light into a user's tissue. Pet. 31–33; *see, e.g.*, Ex. 1012, 9:22–40 ("The sensor 10 comprises . . . light source 12 composed of three closely spaced light emitting elements (e.g., LEDs or laser sources) 12a, 12b and 12c generating light of three different wavelengths."), Fig. 7 (LEDs or laser sources 12a, 12b and 12c); *see also id.* at 9:42–10:15 (noting that "[t]he actual numbers of wavelengths used as a light source and the number of

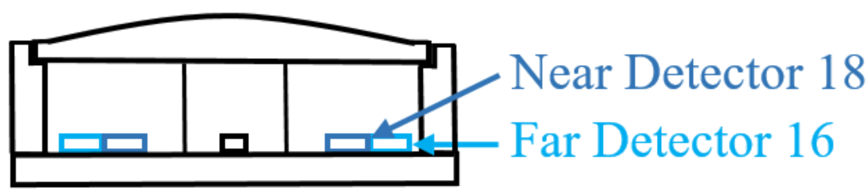
[2] Whether the preamble is limiting need not be resolved, because Petitioner shows persuasively on the final record that the recitation in the preamble is satisfied by the prior art.

photodetectors in each ring are not limited and depend only on the electronic circuitry inside the oximeter"). Further, Dr. Kenny persuasively testifies that "[f]rom this and related description, one of ordinary skill would have understood that Mendelson '799 discloses a plurality of emitters configured to emit light into tissue of a user." Ex. 1003 ¶ 106; *see also id.* ¶¶ 55–69, 78–98, 104–107.

iii. "[b] at least four detectors, wherein at least one of the at least four detectors is configured to detect light that has been attenuated by tissue of the user, and wherein the at least four detectors are arranged on a substrate;"

Based on the final record, the cited evidence supports Petitioner's undisputed contentions regarding this limitation. Pet. 33–36. Specifically, Petitioner contends that Mendelson-799 discloses twelve photodetectors located within a sensor housing. Pet. 33; *see, e.g.*, Ex. 1012, 9:22–48 ("The sensor 10 comprises . . . an array of discrete detectors (e.g., photodiodes)."), Fig. 7 (depicting rings of six far detectors 16 and six near detectors 18). Petitioner further contends that "each of the twelve discrete photodiodes included in the detector assembly illustrated in Mendelson '799's FIG. 7 (reproduced below) are 'adapted to detect reflected radiation . . . and to generate respective signals' that 'are used to determine the parameter of the blood.'" Pet. 33 (quoting Ex. 1012, code (57), 9:22–48). Petitioner provides an annotated and modified view of Mendelson-799's Figure 7, as well as an added sectional view, both of which are reproduced below. Pet. 34; *see also id.* at 38 (similar figures with slightly different annotations).





Petitioner's modified and added figures depict the sensor of Mendelson-799 with "Far Detector 16" (illustrated in light blue) and "Near Detector 18" (illustrated in dark blue).[3] *Id.* at 34.

Petitioner next relies on Figure 3 of Mendelson-799, reproduced below, which depicts traditional reflection-mode or backscatter type pulse oximetry sensors.

[3] Petitioner's annotated figures also include an added opaque wall and an added top cover as discussed *infra*.

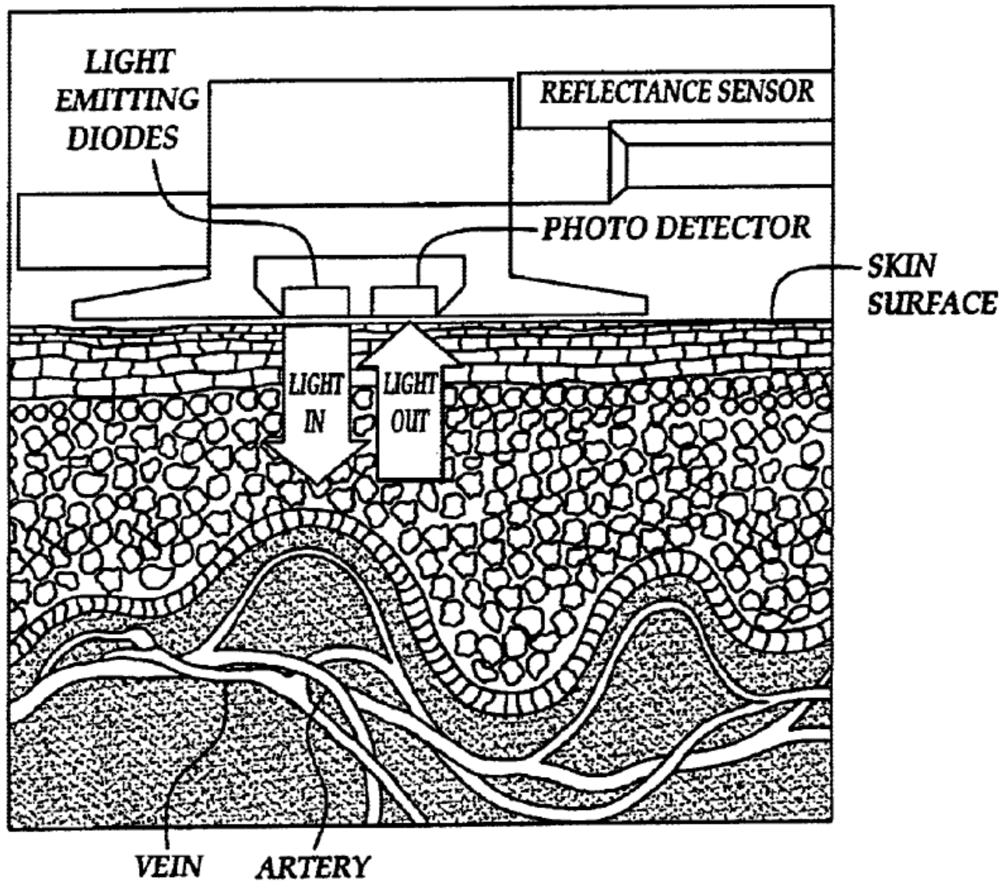


Figure 3 of Mendelson-799 depicts the relative disposition of light source and detector in reflection-mode or backscatter type pulse oximetry. Ex. 1012, 8:26–28. According to Petitioner, the sensor shown in Figure 3 features LEDs and a photodetector that are mounted side-by-side next to each other on the same planar substrate, which allows for measuring SaO_2 from multiple convenient locations on the body. Pet. 34–35 (citing Ex. 1012 2:14–28, Fig. 3; Ex. 1003 ¶¶ 110–111 ("[A]lthough the sensor depicted in Mendelson '799's FIG. 7 features two concentric rings of discrete photodetectors that are arranged in a radially-symmetric manner about central light emitting elements, the photodetectors and the light emitting elements are arranged on the same planar substrate.").

We find Petitioner's contentions for these limitations are persuasive, including by the testimony of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 108–113.

> *iv. "[c] a wall configured to circumscribe at least the at least four detectors; and"*
>
> *"[d] a cover configured to be located between tissue of the user and the at least four detectors when the noninvasive optical physiological sensor is worn by the user, wherein the cover comprises a single protruding convex surface operable to conform tissue of the user to at least a portion of the single protruding convex surface when the noninvasive optical physiological sensor is worn by the user, and wherein the wall operably connects to the substrate and the cover."*

<u>Petitioner's Undisputed Contentions</u>

Petitioner explains that Mendelson-799 does not disclose a cover located between the user's tissue and the at least four detectors, as claimed. Pet. 21–22. Patent Owner does not dispute this contention, and we agree that Mendelson-799 is not shown to include a cover. *See generally* Ex. 1012.

Petitioner contends that although Mendelson-799 does not disclose a cover as claimed, Ohsaki teaches a wrist-worn sensor "that includes a light permeable convex cover—'translucent board 8'— . . . where the cover comprises a single protruding convex surface operable to conform [to] tissue of the user." Pet. 22; *see, e.g.*, Ex. 1009 ¶¶ 16 ("worn on the back side of the user's wrist"), 17 ("convex surface"), Figs. 1–2 (depicting translucent board 8 between tissue and detector); Ex. 1003 ¶ 83. Petitioner also contends that Ohsaki's Figure 2 depicts the user's tissue conforming to the shape of the

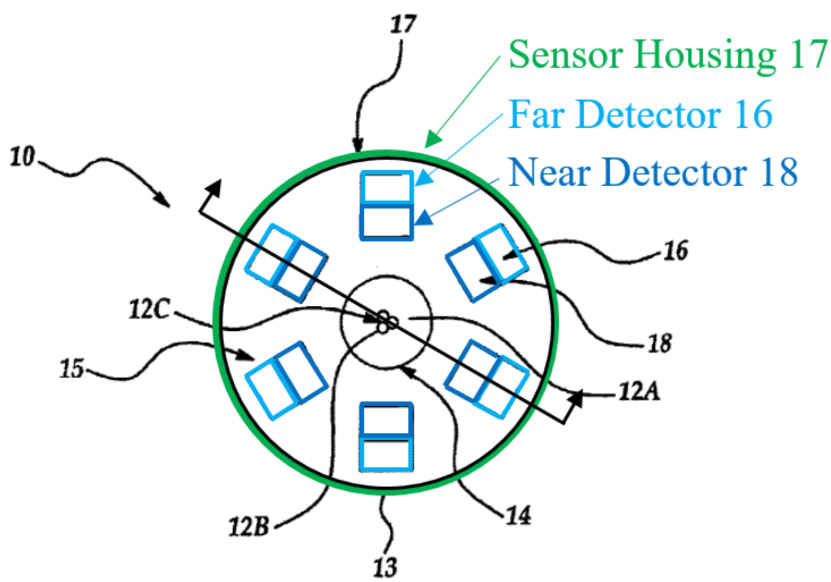
convex surface of the cover. Pet. 23–26, 39–41; *see, e.g.*, Ex. 1003 ¶¶ 55–69, 78–98, 127–136.

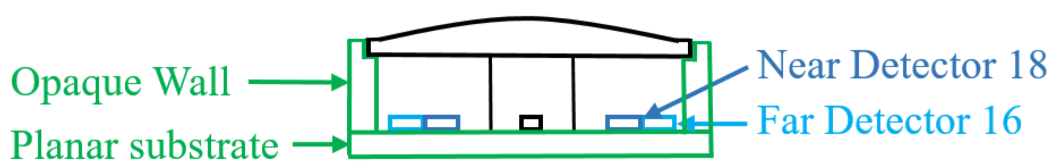
Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki discloses that sensor 1 is "worn on the back side of the user's wrist" and includes translucent board 8, with a single convex surface formed on the top of the board, to be placed against a user's tissue. Ex. 1009 ¶¶ 16, 17, Figs. 1–2 (depicting translucent board 8 between tissue and detector). As shown in Ohsaki's Figure 2, the convex surface of board 8 is operably connected to the walls of sensor package 5 that houses the sensor components, including circuit board 9, light emitting element 6 (e.g., LED), and light receiving element 7. *Id.* ¶ 17 ("The translucent board 8 is . . . attached to the opening of the package 5."), Fig. 2. As depicted in Ohsaki's Figure 2, the user's tissue 4 is shown to conform to the shape of the protruding convex surface when the sensor is worn by the user. Ex. 1009 ¶ 17 ("The translucent board 8 is a glass board."), Fig. 2.

<u>Petitioner's Disputed Contentions</u>

Petitioner contends that Mendelson-799 discloses sensor housing 17 that encircles detectors 16 and 18. Pet. 36–37; *see, e.g.*, Ex. 1012, 9:23–40 ("All these elements are accommodated in a sensor housing 17."), Fig. 7 (housing 17). Petitioner further contends that a person of ordinary skill in the art would have found it obvious "to connect, to the illustrated portion of sensor housing 17, an opaque wall configured to circumscribe the array of discrete detectors included in detector rings 16 and 18" to shield the detectors from ambient light and to protect from external forces. Pet. 37–38; *see, e.g.*, Ex. 1003 ¶¶ 55–69, 78–98, 114–126.

As shown below, Petitioner alleges that it would have been obvious to connect, to the illustrated portion of sensor housing 17, an opaque wall configured to circumscribe the array of discrete detectors included in detector rings 16 and 18. Pet. 37–38. Petitioner relies on Ohsaki's disclosure of a sensor including package 5 having a wall that surrounds light emitting element 6 and light receiving element 7. *Id.*; *see, e.g.*, Ex. 1009 ¶ 17, Fig. 2 (detector 7 surrounded by wall of package 5); Ex. 1003 ¶¶ 115–125.





Above, Petitioner depicts Mendelson-799's Figure 7 and its modified sectional view with several annotations and modifications. Pet. 38; Ex. 1019, Fig. 7. Petitioner's modified and added figures depict the sensor of Mendelson-799 with an added opaque wall (illustrated in green) connected to the planar substrate (also illustrated in green) of housing 17 and

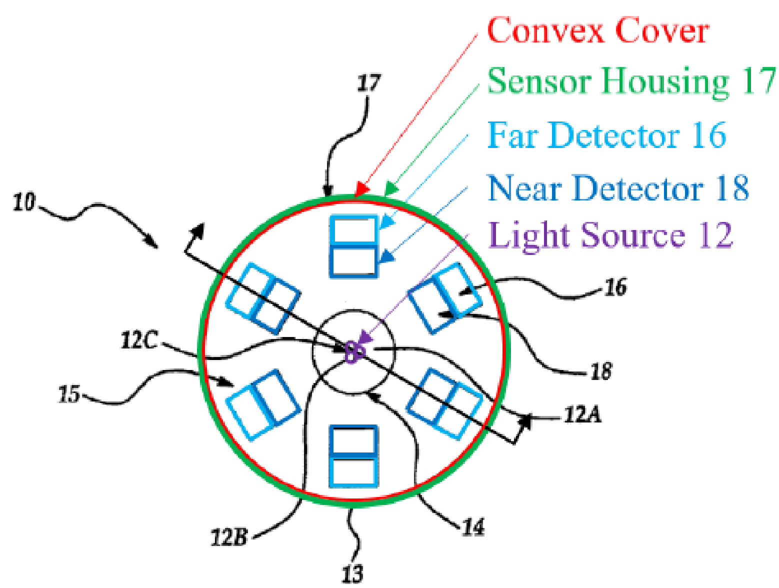
encircling the sensor components, as Petitioner contends would have been obvious to a person of ordinary skill in the art. Pet. 37–39, 26.

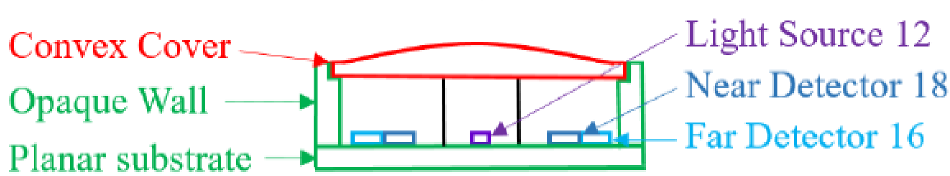
Petitioner further contends that a person of ordinary skill in the art "would have recognized that a light permeable cover with a protruding convex surface," such as that taught by Ohsaki, "would improve adhesion between the sensor and the user's tissue, improve detection efficiency, and protect the elements within sensor housing 17." Pet. 21–22 (citing, e.g., Ex. 1003 ¶ 81; Ex. 1009 ¶¶ 15, 17, 25), 29–30. Petitioner contends that Ohsaki's convex surface is in intimate contact with the user's tissue, which prevents slippage of the sensor and increases signal strength because "variation of the amount of the reflected light . . . that reaches the light receiving element 7 is suppressed" and "disturbance light from the outside" is prevented from penetrating board 8, as compared to a sensor with a flat surface. *Id.* at 23–24 (quoting Ex. 1009 ¶ 25). Dr. Kenny likewise testifies that a person of ordinary skill in the art "would have recognized that a light permeable cover with a protruding convex surface would improve adhesion between the sensor and the user's tissue, improve detection efficiency, and protect the elements within sensor housing 17." Ex. 1003 ¶ 81 (citing Ex. 1009 ¶¶ 15, 17, 25, Figs. 1, 2, 4A, 4B); Pet. 21–22.

Accordingly, Petitioner contends that, to achieve these benefits, a person of ordinary skill in the art "would have added a transparent convex cover to [Mendelson-799's] sensor 10, the cover being located between tissue of the user and the array of detectors 16 and 18 when worn," and would have "configured Mendelson-799's circumscribing wall to operably connect" to the convex and rigid cover. Pet. 25–26, 40–41; *see, e.g.*, Ex. 1003 ¶¶ 55–69, 78–98, 127–136.

Petitioner contends these modifications would have been "nothing more than the use of a known technique to improve similar devices in the same way, and combining prior art elements according to known methods to yield predictable results—improved adhesion of the sensor to the user's skin, and improved signal strength," where "the elements of the resulting sensor would each perform functions they had been known to perform prior to the combination." Pet. 29 (citing, e.g., Ex. 1003 ¶¶ 91–98).

To illustrate its proposed modification, the Petition includes an annotated and modified view of Mendelson-799's Figure 7, as well as an added sectional view, both of which are reproduced below. Pet. 30; *see also id.* at 41 (same).



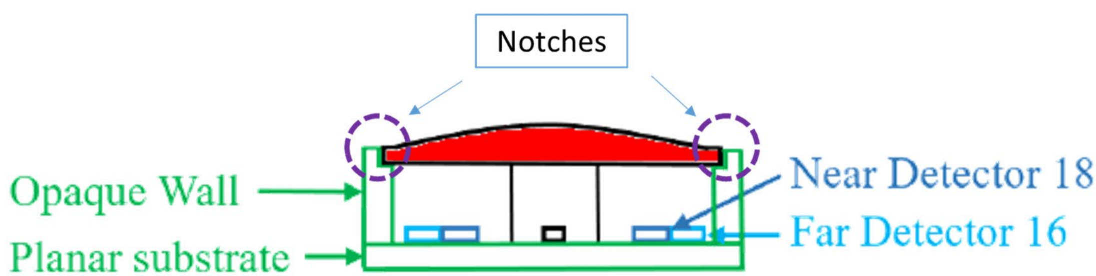


Petitioner's modified and added figures depict the sensor of Mendelson-799 with an added convex cover (illustrated in red) connected to the opaque wall

(illustrated in green) that Petitioner contends would have been obvious to a person of ordinary skill in the art. Pet. 41.

Patent Owner's Contentions

Patent Owner contends that the proposed combination adds features not found in the cited references, with no motivation or explanations for why a person of ordinary skill in the art would have added these features. PO Resp. 12. Patent Owner contends that the depiction of a cover spanning the entire space above the substrate lacks support. Patent Owner notes that Ohsaki places its translucent board in an opening within the top of the package. *Id.* at 13 (citing Ex. 1009, Fig. 2). Patent Owner further contends that the proposed combination includes a wall with notches for the cover, as depicted below in Patent Owner's annotated figure, yet neither Mendelson-799 nor Ohsaki include a notched wall feature. *Id.* (citing Ex. 2004 ¶¶ 46–47; Ex. 2008, 205:21–208:19). Patent Owner provides an annotated figure, reproduced below.



Patent Owner's annotated figure adds purple circles around "Notches" to Petitioner's already annotated figure depicting the proposed combination of a cover, as suggested by Ohsaki, with Mendelson-799's sensor. PO Resp. 13 (original figure at Pet. 38). Patent Owner alleges that the addition of a notch is significant and would impact performance because "the notch insets the cover into the wall, which changes the cover's height relative to

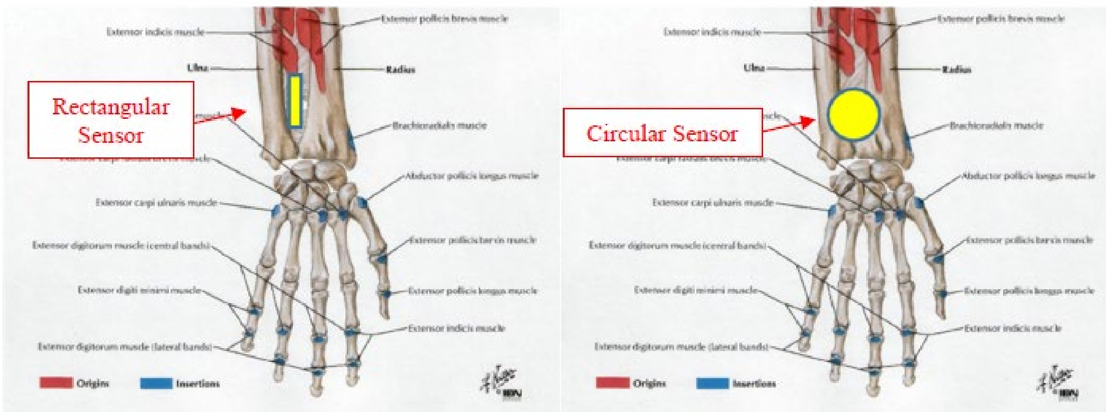
the underlying optical components," and "[t]he notch also uses a light shield shorter than the surrounding wall." *Id.* at 13–14 (Ex. 2004 ¶¶ 46–47).

Patent Owner makes several arguments as to how modifying Ohsaki's rectangular board would eliminate the advantages Ohsaki teaches. PO Resp. 17. First, Patent Owner argues that the proposed modification "changes Ohsaki's structure and eliminates the longitudinal shape that gives Ohsaki's translucent board the ability to fit within the user's anatomy and prevent slipping." *Id.* This argument is premised on Patent Owner's contention that Ohsaki's convex cover must be rectangular, with the cover's long direction aligned with the length of the user's forearm, to avoid interacting with bones in the wrist and forearm. *Id.* at 17–19 (citing, e.g., Ex. 2004 ¶¶ 51–54; Ex. 1009 ¶¶ 6, 19, 23, 24); *see also* Sur-reply 3–8. According to Patent Owner, Ohsaki teaches that "aligning the sensor's longitudinal direction with the ***circumferential*** direction of the user's arm undesirably results in 'a tendency [for Ohsaki's sensor] to slip off.'" *Id.* at 19–20 (citing Ex. 1009 ¶ 19), 20–22; *see also* Sur-reply 4 ("Petitioner never explained how or why a POSITA would change Ohsaki's ***longitudinal*** board into a ***circular*** cover. That change would eliminate the longitudinal shape that Ohsaki indicates prevents slipping.").

Thus, Patent Owner contends that Petitioner's proposed modification would "chang[e] Ohsaki's rectangular board into a ***circular*** shape," which "would eliminate the advantages discussed above" because it "cannot be placed in ***any longitudinal*** direction and thus cannot coincide with the longitudinal direction of the user's wrist." PO Resp. 20 (citing Ex. 2004 ¶¶ 50–57). Patent Owner presents annotated Figures depicting what it

contends is Ohsaki's disclosed sensor placement as compared to that of the proposed modification, reproduced below.

Ohsaki's Longitudinal Teachings Petitioner's Proposed Combination

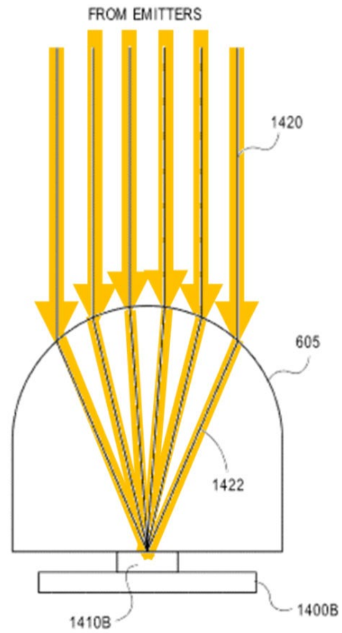


Patent Owner's annotated Figure on the left depicts a rectangular sensor placed between a user's radius and ulna, while Patent Owner's annotated Figure on the right depicts a circular sensor placed across a user's radius and ulna. PO Resp. 21. Based on these annotations, Patent Owner argues that the proposed "circular shape would press on the user's arm in all directions and thus cannot avoid the undesirable interaction with the user's bone structure," such that a skilled artisan "would have understood such a change would eliminate Ohsaki's benefit of preventing slipping." *Id.* at 21–22 (citing, e.g., Ex. 2004 ¶¶ 54–57). Similarly, Patent Owner contends that "adding Ohsaki's ***rectangular*** board to Mendelson '799's oxygen saturation sensor would eliminate the ***radially*** symmetric environment and undermine the reason for Mendelson '799's use of multiple detectors arrayed in a ring pattern." *Id.* at 25 (citing Ex. 1012, 7:25–37).

Second, Patent Owner argues that Ohsaki requires its sensor be placed on the back of the user's wrist to achieve any benefits, but that such a location would have been unsuitable for Mendelson-799's sensor, and would

result in weak sensor signals. PO Resp. 26. Relying on other publications by the named inventor on Mendelon-799, Patent Owner alleges that sensor signals were difficult or impossible to discern from the wrist, even with considerable pressure. *Id.* (citing Ex. 2003, 3–4); *see also id.* at 26–27 (citing Ex. 2015, 3, 4; Ex. 2014, 1, 99; Ex. 2004 ¶ 65). Patent Owner contends that Dr. Kenny admitted during cross examination that signals from the wrist are weaker and noisier than signals from other locations. *Id.* at 27 (citing Ex. 2008, 249:10–16, 255:12–21); *see also id.* at 27–30 (citing Ex. 2017, 2; Ex. 2018, 4 ("reflected red and infrared pulses can only be used for specific areas, such as a radial artery; thus, most areas of the wrist are not available for monitoring"); Ex. 2010, 44, 71; Ex. 2016, 2, 3).

Third, Patent Owner argues that a person of ordinary skill in the art would not have placed Ohsaki's convex cover over Mendelson-799's peripheral detectors because the convex cover would condense light toward the center and away from the detectors, which would decrease signal strength. PO Resp. 31–34 (citing, e.g., Ex. 2004 ¶¶ 71–75). Patent Owner relies on Figure 14B of the '553 patent, which Patent Owner contends supports its position. *Id.* at 32–33 (citing Ex. 1001, 36:3–6, 36:13–15).



Patent Owner's annotated Figure 14B of the '553 patent adds highlighting to show direction of the light. PO Resp. 33. According to Patent Owner, the convex shape directs light from the periphery toward the center. *Id.* at 32; *see also* Sur-reply 16 ("Petitioner and Dr. Kenny both admitted a convex cover condenses light towards the sensor's center and away from the sensor's periphery.").

Patent Owner also contends that Dr. Kenny admits as much, fails to account for the impact of the proposed modification on light collection, and fails to propose a specific three-dimensional structure to embody the proposed modification. PO Resp. 32–37 (citing, e.g., Ex. 2004, 71–72; Ex. 2006, 204:14–20; Ex. 2008, 36:19–37:1, 57:19–58:16, 63:5–64:8, 170:12–171:1, 173:8–15). Patent Owner argues that "[d]espite testifying that all the design details would be critical in assessing the impact on optics, neither Petitioner nor Dr. Kenny provide ***any analysis*** of the impact of Petitioner's modifications on light collection by the detectors," and "Petitioner's failure to address optics is particularly glaring because the

invention is a noninvasive ***optical*** physiological sensor (claim 1) or measuring device (claim 20)." PO Resp. 35.

Fourth, Patent Owner argues that Ohsaki's rectangular cover creates air gaps at its peripheral edges, as shown in Ohsaki's Figure 1, which Mendelson-799 cautions against as potentially causing "specular reflection." PO Resp. 36–37 (citing, e.g., Ex. 1012, 2:58–64; Ex. 2004 ¶ 76). Patent Owner, relying on the testimony of Dr. Madisetti, contends that a person of ordinary skill in the art "would have understood that air gaps near the detectors on the peripheral edge of Mendelson '799's more complicated oximeter sensor would create significant noise." *Id.* at 38 (citing Ex. 2004 ¶ 79 ("peripheral air gaps would be positioned near or over Mendelson '799's peripheral detectors leading to inconsistent measurements")). Accordingly, Patent Owner argues that a person of ordinary skill in the art would not have modified Mendelson-799's structure to add Ohsaki's air gaps. *Id.* at 37–38 (citing Ex. 2004 ¶¶ 77–79).

Fifth, Patent Owner argues that "a convex cover is just one of many different alternatives for protecting the components of a sensor" including, e.g., resin or encapsulation. PO Resp. 38–40. Concerning possible alternatives, Patent Owner contends that a person of ordinary skill in the art "would have understood that a flat cover would provide ***better protection*** than a convex surface because, as Petitioner's cited art teaches, it would be less prone to scratches." *Id.* at 39–40 (citing Ex. 1008 ¶ 106).

Patent Owner further argues that "Petitioner fails to provide evidence that its combination, with its many flaws, would reasonably be expected to successfully result in an effective noninvasive optical physiological sensor or measurement device." PO Resp. 40. Patent Owner relies on testimony

that the design analysis required to create a functional optical physiological sensor would be complex and involve trial and error. *Id.* Yet, even with such a design, "Dr. Kenny admitted he did ***no*** analysis to see what impact his proposed changes would have on the operability of his proposed combination, nor could he explain what effect any changes to the sensors would ultimately have on the operability of his proposed combination." *Id.*

Petitioner's Reply

In its Reply, Petitioner reiterates that "Ohsaki would have motivated one of ordinary skill to add a light permeable protruding convex cover to Mendelson '799's sensor, to [1] improve adhesion between the sensor and the user's tissue, to [2] improve detection efficiency, and to [3] provide additional protection to the elements accommodated within sensor housing 17." Pet. Reply 1 (quoting Ex. 1003 ¶ 87). Examining Patent Owner's arguments related to shape, structure, and location of sensors, Petitioner notes that Ohsaki does not limit its benefits to a rectangular pulse rate sensor applied to a particular body location. *Id.* at 2. Instead, Petitioner argues that Ohsaki attributes the reduction of slippage afforded by use of a translucent board, and related improvements in signal quality, to the convex surface of the translucent board being in intimate contact with the surface of a user's skin. *Id.* (citing Ex. 1003 ¶ 84; Ex. 1009 ¶¶ 15, 17–18, 25, Figs. 1, 2, 4A, 4B).

Concerning Patent Owner's first and second arguments (longitudinal shape and sensor placed on the back of the user's wrist), Petitioner responds that Ohsaki does not disclose the shape of its protrusion, other than its convexity as shown in Figures 1 and 2, nor does Ohsaki require a rectangular shape or placement on the back of the wrist in order to achieve

the disclosed benefits. Pet. Reply 6–12 (citing, e.g., Ex. 1047 ¶¶ 21–30). Moreover, Petitioner asserts that "even if Ohsaki's translucent board 8 were somehow understood to be rectangular, obviousness does not require 'bodily incorporation' of features from one reference into another"; rather, a person of ordinary skill in the art "would have been fully capable of attaching a light permeable protruding convex cover to Me[nd]elson-799's housing to obtain the benefits attributed to such a cover by Ohsaki." *Id.* at 10 (citing, e.g., Ex. 1047 ¶ 26). Similarly, regarding the location of the sensor, Petitioner asserts,

> [E]ven if a [person of ordinary skill in the art] would have somehow misunderstood Ohsaki's sensor as limited to placement on the backside of the wrist, and even if the difficulty that [Patent Owner] alleges with respect to obtaining pulse oximetry measurements from that location were true, that ***would have further motivated*** the [person of ordinary skill in the art] to implement a light permeable convex cover in Mendelson-799's sensor, to improve detection efficiency.

Id. at 11 (citing, e.g., Ex. 1047 ¶ 28).

Concerning Patent Owner's third argument, Petitioner responds that adding a convex cover to Mendelson-799's sensor would not decrease signal strength but, instead, "would improve Mendelson-799's signal-to-noise ratio by causing more light backscattered from tissue to strike Mendelson-799's detectors than would have absent the cover" because such a cover improves light concentration across the entire lens and does not direct it only towards the center. *Id.* at 13–17 (citing, e.g., Ex. 1047 ¶¶ 31–47).

Petitioner dismisses Patent Owner's reliance on Figure 14B of the '553 patent because it "is not an accurate representation of light that has been reflected from a tissue measurement site. For example, the light rays (1420) shown in FIG. 14B are collimated (i.e., travelling paths parallel to

one another), and each light ray's path is perpendicular to the detecting surface." Pet. Reply 14–15 (citing, e.g., Ex. 1047 ¶¶ 32–34). Moreover, Petitioner argues that, even when collimated, light will focus at the center only if the light beam happens to be perfectly aligned with the axis of symmetry of the lens and, when entering at any other angle, will focus at a different point. *Id.* at 15 (citing, e.g., Ex. 1047 ¶ 34).

According to Petitioner, Patent Owner's and Dr. Madisetti's position regarding convergence toward the center does not apply to diffuse light, which reaches the detectors from various random angles and directions after having been reflected by tissue. *Id.* at 15–16 (citing, e.g., Ex. 1047 ¶¶ 36–37). As a result, Petitioner contends Ohsaki's cover would have provided a refracting effect such that light rays that would have missed the detectors absent a cover are instead directed to that area as they pass through the cover. *Id.* at 16–17 (citing Ex. 1047 ¶¶ 37–39). Dr. Kenny testifies how the light that backscatters from the measurement site after diffusing through tissue reaches the circular active detection area of Mendelson-799's detectors and further applies principles of Snell's law to explain the effects of the convex board on the propagation of light rays from a diffuse source. Ex. 1047 ¶ 37, 39–43. Petitioner thus contends that "overall, more of the partially reflected, transmitted, absorbed, and ultimately back scattered light strikes the detectors than otherwise would have absent the cover." Pet. Reply 17–18 (citing Ex. 1047 ¶¶ 45–47).

Concerning Patent Owner's fourth argument, Petitioner responds that a skilled artisan would have known to avoid air gaps in the proposed combination. *Id.* at 18 (citing, e.g., Ex. 1047 ¶¶ 48–49). Further, Petitioner

contends that "some minor air gaps" would not obviate the motivation to combine even if they remained. *Id.* at 19.

Concerning Patent Owner's fifth argument, Petitioner responds that even if a flat surface might be less prone to scratching, that possible disadvantage would have been weighed against the "multiple advantages of a convex cover," and would not negate a motivation to combine. *Id.* at 19–20 (citing, e.g., Ex. 1047 ¶ 52).

Patent Owner's Sur-reply

Concerning Patent Owner's first and second arguments, Patent Owner reiterates its position that Ohsaki's purported benefits attach only to a sensor with a rectangular convex surface that is located on the back of the wrist, and that "even small changes in sensor orientation or measurement location result in slippage." Sur-reply 3–14, 8.

Concerning Patent Owner's third argument, Patent Owner argues that Dr. Kenny and Petitioner have not overcome their admissions that a convex lens directs light toward the center. *Id.* at 15–16 (citing, e.g., Ex. 2004 ¶¶ 71–72).

Patent Owner also asserts that Petitioner mischaracterizes Patent Owner's position, which is not that a convex cover focuses "***all*** light" to a single point at the center of the sensor. *Id.* at 17. Patent Owner instead states that, "[l]ight entering the convex surface from ***all*** angles would, on ***average***, result in ***more light directed towards the center*** and ***less light at the periphery***—as compared to a flat surface—and therefore less light at the peripherally located detectors." *Id.* (citing Ex. 2004 ¶¶ 70–75).

Finally, Patent Owner argues that Petitioner's Reply arguments are overly complex and instead a person of ordinary skill in the art "would have

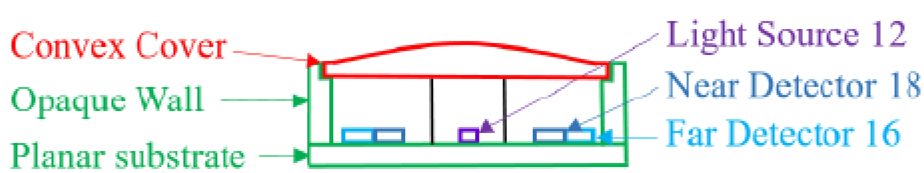
understood and applied the straightforward understanding that a convex surface condenses light toward the center." *Id.* at 19–20.

Concerning Patent Owner's fourth argument, Patent Owner argues that "Petitioner does not dispute that . . . air gaps would dissuade a [person of ordinary skill in the art] from modifying Mendelson[-]799." *Id.* at 20–21.

Concerning Patent Owner's fifth argument, Patent Owner argues that Petitioner does not dispute Patent Owner's position that a flat cover would be less prone to scratches and offers "***no*** plausible advantages for its asserted combination." *Id.* at 22–23. Moreover, Patent Owner argues that "the risk of scratches is not merely a disadvantage—it directly undermines Petitioner's motivation to add a convex cover to provide 'additional ***protection***.'" *Id.* at 23.

Analysis

We have considered the parties' arguments and cited evidence, and we are persuaded by Petitioner's contentions. As shown in Petitioner's modified figures below, the wall of the combined sensor surrounds the sensor components and is operably connected to the convex cover on the top and is operably connected to the planar substrate on the bottom, as claimed.



Petitioner's annotated Figure 7 from Mendelson-799 shows the proposed combination with a convex cover (red), and opaque wall and planar substrate (green). Pet. Reply 5; *see also* Ex. 1003 ¶ 88 ("[O]ne of ordinary skill would have configured Mendelson 799's circumscribing wall to operably

connect, on one side, to the planar substrate on which detectors 16 and 18 are arranged and, on an opposite side, to the convex cover.”). We credit Dr. Kenny’s testimony that a person of ordinary skill in the art would have been motivated to configure the wall, substrate and convex cover such that the circumscribing wall operably connects, on one side, to the planar substrate on which detectors 16 and 18 are arranged and, on an opposite side, to the convex cover. *See id.*

Moreover, as discussed more below, Petitioner’s proposed modifications to Mendelson-799 are *not* premised upon bodily incorporating Ohsaki’s cover directly with Mendelson-799’s sensor. *See In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973) (“Combining the teachings of references does not involve an ability to combine their specific structures.”). To the contrary, Petitioner proposes incorporating Ohsaki’s *teaching* of a cover with a convex surface, not the precise cover and structure disclosed by Ohsaki. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (“[T]he test is what the combined teachings of those references would have suggested to those of ordinary skill in the art.”). If Ohsaki’s teaching is implemented in a manner that varies from the precise implementation of such a cover in Ohsaki, e.g., with a larger span or with notches, this is not a material deviation from Ohsaki’s express teachings of using a cover with a convex surface to achieve specific benefits, e.g., improved adhesion and signal strength. Ex. 1009 ¶ 25; *see supra* § II.D.5.vi; *see Lear Siegler, Inc. v. Aeroquip Corp*., 733 F.2d 881, 889 (Fed. Cir. 1984) (explaining that a person of ordinary skill is not “compelled to adopt every single aspect of [a reference] without the exercise of independent judgment”). As explained by Dr. Kenny, a person of ordinary skill in the art “would have found it obvious to add notches to

improve the reliability of the connection between the convex cover and housing." Ex. 1047 ¶ 55 (citing Ex. 2008, 208:1–5, 206:20–207:4). Based on the final record, Petitioner's stated reasoning for the proposed modifications are sufficiently supported, including by the testimony of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 55–69, 78–98, 127–136.

As noted above, Petitioner provides three rationales to support its contention that a person of ordinary skill in the art would have provided "a light permeable cover with a protruding convex surface," such as that taught by Ohsaki, to Mendelson-799's sensor: (1) to "improve adhesion between the sensor and the user's tissue," (2) to "improve detection efficiency," and (3) to "protect the elements within sensor housing 17." Pet. 25 (citing, e.g., Ex. 1003 ¶ 87; Ex. 1009 ¶¶ 15, 17, 25). As further examined below, we determine all three rationales are supported by the evidence, and further that any single rationale standing alone would have been sufficient to establish a basis for the person of ordinary skill in the art to combine the references as proposed.

Rationales 1 and 2

The evidence of record persuades us that adding a convex cover, such as that taught by Ohsaki, would have improved adhesion between the sensor and the user's skin, which would have increased the signal strength of the sensor. Ohsaki teaches as much:

> [T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby *it is prevented that the detecting element 2 slips off* the detecting position of the user's wrist 4. If the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4 as shown in Fig. 4B. However, in the case that the translucent board 8 has a convex surface like the present embodiment, the *variation of the amount of the*

> *reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8*. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25 (emphases added); *see also id.* ¶ 27 ("stably fixed").

We credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated by such teachings to apply a cover with a convex surface to Mendelson-799 to improve that similar device in the same way and to yield predictable results, i.e., to resist movement of the sensor on the user's wrist. *See, e.g.*, Ex. 1003 ¶ 84 ("[T]his contact between the convex surface and the user's skin is said to prevent slippage, which increases the strength of the signals obtainable by Ohsaki's sensor."). We also credit Dr. Kenny's testimony that, in light of these teachings, a person of ordinary skill in the art would have made such a modification to improve the pulse sensor's ability to emit light into, and detect light reflected from, the user's wrist, to generate an improved pulse signal. Ex. 1003 ¶¶ 83–87; Ex. 1047 ¶ 17.

Indeed, Ohsaki expressly compares the performance of a wrist-worn pulse wave sensor depending on whether translucent board 8 is convex or flat, and concludes the convex surface results in improved performance over the flat surface, especially when the user is moving. Ex. 1009, Figs. 4A–4B, ¶¶ 15, 25 (stating that with "a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4," and with "a convex surface like the present embodiment, the variation of the amount of the reflected light" collected by the sensor "is suppressed"). Ohsaki also

states that, with a convex surface, "[i]t is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8." *Id.* ¶ 25.

We also credit Dr. Kenny's testimony that the proposed modification would have been within the level of ordinary skill in the art. For example, Dr. Kenny testifies:

> The above-described modification would require only routine knowledge of sensor design and assembly. . . . Indeed, the modification would have amounted to nothing more than the use of a known technique to improve similar devices in the same way, and combining prior art elements according to known methods to yield predictable results—improved adhesion of the sensor to the user's skin, and improved signal strength.
>
> Furthermore, the elements of the resulting sensor would each perform functions they had been known to perform prior to the combination—Ohsaki's translucent board 8 would simply be placed over the components accommodated within Mendelson '799's sensor housing 17, and would perform the same function as taught by Ohsaki.

Ex. 1003 ¶¶ 97–98; *see also id.* ¶¶ 88–90. In light of Ohsaki's express disclosure of the benefits of a convex cover, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to modify Mendelson-799 as proposed, and would have had a reasonable expectation of success in doing so.

We next address Patent Owner's first through fourth arguments, each of which implicates Petitioner's first and second asserted rationales of improved adhesion and detection efficiency.

Patent Owner's first argument is premised on the notion that Ohsaki's benefits only can be realized with a rectangular convex surface, because such a shape is required to avoid interacting with bones on the back of the

user's forearm. PO Resp. 17–25. We disagree. Ohsaki does not disclose the shape of its convex cover, much less require it be rectangular. In fact, Ohsaki is silent as to the shape of the convex surface. Ohsaki discloses that sensor 1 includes detecting element 2, which includes package 5 within which the sensor components are located. Ex. 1009 ¶ 17. Ohsaki's convex surface is located on board 8, which is "attached to the opening of the package 5." *Id.* Ohsaki provides no further discussion regarding the shape of board 8 or its convex surface.

We disagree with Patent Owner's suggestion that the shape of the convex surface can be inferred to be rectangular from Ohsaki's Figures 1 and 2. PO Resp. 17–21. Ohsaki does not indicate that these figures are drawn to scale, or reflect precise dimensions or shapes of the convex surface. *See, e.g.*, Ex. 1009 ¶ 13 ("schematic diagram"); *see also* Pet. Reply 9; *Hockerson-Halberstadt, Inc. v. Avia Group Int'l*, 222 F.3d 951, 956 (Fed. Cir. 2000) ("[I]t is well established that patent drawings do not define the precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue.").

To be clear, Ohsaki describes the shape of *detecting element 2* as rectangular: "[T]he length of the detecting element 6 from the right side to the left side in FIG. 2 is longer than the length from the upper side to the lower side." Ex. 1009 ¶ 19. Ohsaki also describes that detecting element 2 is aligned longitudinally with the user's forearm: "[I]t is desirable that the detecting element 2 is arranged so that its longitudinal direction agrees with the longitudinal direction of the user's arm," to avoid slipping off. *Id.*; *see also id.* ¶ 9 ("The light emitting element and the light receiving element are arranged in the longitudinal direction of the user's arm.").

In light of this disclosed rectangular shape of detecting element 2, it is certainly possible that Ohsaki's convex surface may be similarly shaped. But, it may not be. Contrary to Patent Owner's argument, Ohsaki neither describes nor requires detecting element 2 to have the same shape as the convex surface of board 8. *Accord* Pet. Reply 7–8 (noting also that Ohsaki's board 8 "is not coextensive with the entire tissue-facing side of detecting element 2"). We have considered the cited testimony of both Dr. Kenny and Dr. Madisetti on this point. Ex. 1047 ¶¶ 21–24; Ex. 2004 ¶¶ 38–42 (relying on Ohsaki's Figures 1–2 to support his opinion that the convex surface is rectangular). Dr. Madisetti's reliance on the dimensions of Ohsaki's figures is unpersuasive. *Hockerson-Halberstadt*, 222 F.3d at 956. We credit Dr. Kenny, who testifies that Ohsaki does not describe its convex surface as rectangular, because this testimony is most consistent with Ohsaki's disclosure.

Further, Patent Owner suggests that the convex surface *must be* rectangular, in order to avoid interacting with bones in the user's forearm. Sur-reply 6 ("intended placement take advantage of the forearm/wrist area's particular bone structure to prevent slipping"), 9 ("[A] POSITA would have understood Ohsaki's convex board must also have a longitudinal shape oriented up-and-down the watch-side of the user's wrist/forearm."). Although Ohsaki recognizes that interaction with these bones can cause slippage problems, *see* Ex. 1009 ¶¶ 6, 19, we do not agree that the *only way* to avoid these bones is by aligning a rectangular cover with the longitudinal direction of the user's forearm. For example, in the annotated Figures provided by Patent Owner, *see* PO Resp. 20–21, we discern that the circular sensor that purports to depict the proposed modification would *also* avoid

the bones in the forearm if it were slightly smaller. Patent Owner provides no persuasive explanation to justify the dimensions it provides in this annotated figure, or to demonstrate that such a large circular sensor would have been required. Indeed, we discern that it would have been within the level of skill of an ordinary artisan to appropriately size a modified sensor to avoid these well-known anatomical obstacles. "A person of ordinary skill is also a person of ordinary creativity, not an automaton." *KSR Int'l Co.*, 550 U.S. at 421. After all, an artisan must be presumed to know something about the art apart from what the references disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962).

Finally, we do not agree with Patent Owner's position that Ohsaki's advantages apply only to rectangular convex surfaces. As discussed, Patent Owner has not shown that Ohsaki's convex surface is rectangular at all. Moreover, even if Ohsaki's convex surface is rectangular, when discussing the benefits associated with a convex cover, Ohsaki does not limit those benefits to a cover of any particular shape. Instead, Ohsaki explains that "detecting element 2 is arranged on the user's wrist 4 so that the convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby it is prevented that the detecting element 2 slips off the detecting position of the user's wrist 4." Ex. 1009 ¶ 25; Ex. 1047 ¶ 15 ("Ohsaki nowhere describes its benefits as being limited to a rectangular pulse rate sensor applied to a particular body location. . . . Instead . . . Ohsaki attributes the reduction of slippage afforded by use of translucent board 8" to the convex surface being in intimate contact with the skin.). Thus, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a

surface to Mendelson-799's circular-shaped sensor, to improve adhesion as taught by Ohsaki. *See, e.g.*, Pet. 21–25. Nothing in Ohsaki's disclosure limits such a benefit to a specific shape of the convex surface. Ex. 1047 ¶¶ 11–12.

Moreover, Ohsaki contrasts its convex surface with a flat surface and notes that,

> in the case that the translucent board 8 has a convex surface . . . the variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25; Ex. 1047 ¶ 17. Thus, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Mendelson-799's sensor, to improve signal strength, as taught by Ohsaki. *See, e.g.*, Pet. 23–27. Again, nothing in Ohsaki's disclosure limits such a benefit to the shape of the convex surface. Ex. 1047 ¶¶ 15–17.

Accordingly, we do not agree that Ohsaki's disclosed advantages attach only to a rectangular convex surface, or would have been inapplicable to the proposed combination of Mendelson-799 and Ohsaki.[4]

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[4] Patent Owner also argues that, to the extent contended by Petitioner, it would not have been obvious to place a rectangular cover on top of Mendelson-799's sensor. PO Resp. 29–31. We do not understand Petitioner to have made any such contention and, accordingly, do not address this argument. *See, e.g.*, Pet. 31 (depicting circular convex surface over circular sensor).

We have considered Patent Owner's second argument, that Ohsaki's benefits are realized only when the sensor and convex surface are placed on the back of the user's wrist, which is an unsuitable location for Mendelson-799's sensor. PO Resp. 26–30. We do not agree. As an initial matter, Petitioner does not propose bodily incorporating the references; Petitioner simply proposes adding a convex cover to Mendelson-799's sensor, without discussing where Mendelson-799's sensor is used. *See, e.g.*, Pet. 25–26. In other words, Petitioner's proposed modification does not dictate any particular placement. Moreover, Mendelson-799 states that its sensor "allows for measuring SaO_2 from multiple convenient locations on the body (e.g. the head, torso, or upper limbs)." Ex. 1012, 2:17–19; *see also* Ex. 1019, 104[5] ("The idea of using skin reflectance spectrophotometry marked a significant advancement in the noninvasive monitoring of SaO_2 from virtually any point on the skin surface."). Thus, we do not agree that Mendelson-799 discourages or disparages use on the back of the wrist, or suggests that an unacceptably weak signal would be obtained from another location.

Notwithstanding the foregoing, and assuming for sake of argument that a person of ordinary skill in the art would have expected a weaker signal if Mendelson-799's sensor was used on the back of the wrist, that alone does not nullify the proposed combination. "[A] given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine." *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) (citation omitted). Indeed, we discern that, in such a location that results in decreased signal quality, a person of ordinary

[5] Citation to Petitioner's added page numbering.

skill in the art would have been further motivated to improve signal quality, e.g., by employing Ohsaki's convex surface. *See, e.g.*, Ex. 1047 ¶¶ 27–30; Ex. 1009 ¶ 25 ("[I]n the case that the translucent board 8 has a convex surface like the present embodiment, the variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.").

We have considered Patent Owner's third argument that a convex cover would condense light away from Mendelson-799's peripheral detectors, which Patent Owner alleges would decrease signal strength. PO Resp. 31–36. We disagree. There appears to be no dispute that when emitted light that passes through user tissue, the light is diffused and scattered as it travels. *See, e.g.*, Pet. Reply 13–18; Tr. 27:18–28:3 (Petitioner's counsel agreeing that "the incoming light from a detection standpoint is going to be coming from all sorts of different directions because of the randomness caused by the back scattering"), 65:23–66:13 (Patent Owner's counsel agreeing that light does not simply enter tissue and come back out "like it came out on a mirror"); Ex. 1041, 35:19–37:18 (Patent Owner's declarant describing light scattering as it travels through tissue, e.g., reflecting off blood, tissue, or other material); Ex. 1043, 28:2–10 (Patent Owner's declarant agreeing that reflecting light can be a signal for the '553 patent's sensor), 61:20–62:4 (explaining that "a light in this context, light emitted from the LEDs is diffused through the skin in that particular context, whatever that is."). The light thus travels at random angles and directions, and no longer travels in a collimated and perpendicular manner.

Dr. Kenny testifies that Mendelson-799 and Ohsaki detect light that has been partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector. Ex. 1047 ¶ 36. Dr. Kenny further opines that, "the POSITA would have understood that Mendelson-799's sensor, which includes multiple photodiodes placed symmetrically with respect to a central light source, offers the advantage of *enabling a large fraction of light randomly backscattered from tissue to be detected within the circular active detection area surrounding that source*," thus increasing the light-gathering ability of Mendelson-799's sensor. *Id.* ¶ 43 (emphasis added); *see also id.* ¶ 44 ("Ohsaki's cover provides a refracting effect, such that light rays that otherwise would have missed the detection area are instead directed toward that area as they pass through the interface provided by the cover.").

By contrast Dr. Madisetti testifies that "a convex surface condenses light away from the periphery and towards the sensor's center." Ex. 2004 ¶ 73. We have considered this testimony; however, Dr. Madisetti's opinions largely are premised upon the behavior of collimated and perpendicular light as depicted in Figure 14B of the challenged patent. *See id.* Dr. Madisetti does not persuasively explain how light would behave when approaching the sensor from various angles, as it would after being reflected by tissue. *Id.* ¶¶ 71–75. In other words, even if Patent Owner is correct that the '553 patent's Figure 14B depicts light condensing toward the center, this is not dispositive to the proposed modification, because light passing through a user's tissue is scattered and random, and is not collimated and perpendicular as shown in Figure 14B. Ex. 1001, Fig. 14B.

Patent Owner and Dr. Madisetti argue that "Petitioner and Dr. Kenny both previously admitted that a convex cover condenses light towards the center of the sensor and away from the periphery in a different petition filed against a related patent," i.e., in IPR2020-01520. PO Resp. 31–32; Ex. 2004 ¶¶ 71–72 (citing Ex. 2019, 45; Ex. 2020 ¶¶ 69–70). The cited portions of the Petition and Dr. Kenny's declaration from IPR2020-01520 discuss a decrease in the "mean path length" of a ray of light when it travels through a convex lens rather than through a flat surface. *See, e.g.*, Ex. 2020 ¶¶ 118–120. We do not agree that this discussion is inconsistent with Dr. Kenny's testimony here that, where light is reflected to the detectors at various random angles and directions, more light will reach Mendelson-799's symmetrically disposed detectors when travelling through the convex surface than would be reached without such a surface, because light that might have otherwise missed the detectors now will be captured. Ex. 1047 ¶¶ 43–45. We do not discern that the convergence of a single ray of light toward the center, as discussed in IPR2020-01520, speaks to the aggregate effect on *all* light that travels through the convex surface. Patent Owner suggests that this prior discussion means that all light is always directed toward the center regardless of where or how the light approaches the convex surface (PO Resp. 31–33), however, we do not understand Dr. Kenny's testimony to support such a position.

In its Sur-reply, Patent Owner argues that it "never argued that all incoming light condenses to a ***single point***," or "that ***all*** light would be focused at the center." Sur-reply 16–17. Be that as it may, neither Patent Owner nor Dr. Madisetti sufficiently addresses the diffuse nature of the light at issue here, which reflects from user tissue and scatters. Patent Owner

attempts to do so in its Sur-reply, stating that "light entering the convex surface from all angles would, on average, result in more light directed towards the center and less light at the periphery—as compared to a flat surface—and therefore less light at the peripherally located detectors." *Id.* at 17 (emphases omitted). However, as support, Patent Owner identifies only the same portions of Dr. Madisetti's declaration discussed above, which fail to address diffuse or scattered light. Ex. 2004 ¶¶ 70–75. Accordingly, considering all evidence of record, we credit the testimony of Dr. Kenny.[6]

With respect to Patent Owner's fourth argument, we do not agree that a person of ordinary skill in the art would have been discouraged from modifying Mendelson-799 as proposed, due to the potential for air gaps to form at the peripheral edges of the convex surface. PO Resp. 36–38. Patent Owner misstates the proposed modification. Petitioner does not propose "modif[ying] Mendelson[-]799's structure to add Ohsaki's air gaps." *See* PO Resp. 37. Petitioner proposes modifying Mendelson-799 only to include a cover with a convex surface; Petitioner does not propose including any air gaps that may be present in Ohsaki. *See, e.g.*, Pet. 41. Moreover, even if Ohsaki's Figure 1 depicts small air gaps adjacent the convex surface, Ohsaki nonetheless discloses that the convex surface is in "intimate contact" with the user's skin. Ex. 1009 ¶ 25; *see also Hockerson-Halberstadt*, 222 F.3d at 956. In view of such a teaching, we agree with Petitioner that it would have

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[6] Moreover, we disagree with Patent Owner's argument that Petitioner's Reply arguments are overly complex and instead a person of ordinary skill in the art "would have understood and applied the straightforward understanding that a convex surface condenses light toward the center." Sur-reply 19–20. As noted above, this "straightforward understanding" lacks sufficient support, in the context of diffuse light.

been within the skill of a person of ordinary skill in the art, who "is also a person of ordinary creativity, not an automaton," to minimize any such air gap that may be present when including a cover with a convex surface in Mendelson-799's sensor. Indeed, a purpose of Petitioner's proposed modification is to increase signal strength. *See, e.g.*, Pet. 24–25. We discern that it would have been within the capability of an ordinarily skilled artisan to eliminate any air gap that would have decreased signal strength or quality. Ex. 1047 ¶ 48.

Rationale 3

Petitioner further contends that a person of ordinary skill in the art "would have recognized that a light permeable cover with a protruding convex surface," such as that taught by Ohsaki, would "protect the elements within sensor housing 17" of Mendelson-799. Pet. 21–22. We are persuaded that adding a convex cover, such as that taught by Ohsaki, would protect the sensor's internal components. Mendelson-799 is not shown to include a cover over its emitters 12a–c or detectors 16, 18. *See, e.g.*, Ex. 1012, Fig. 7. By contrast, Ohsaki discloses that translucent board 8 with its convex surface covers its emitter and detector. As such, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to add a transparent convex cover to Mendelson-799 to "provide additional protection to the elements accommodated within sensor housing 17." Ex. 1003 ¶ 87.

We disagree with Patent Owner's fifth argument that a person of ordinary skill in the art would not have modified Mendelson-799 as proposed because a convex cover would be prone to scratches and because other alternatives existed. PO Resp. 38–49. Patent Owner's counsel did not

dispute, during the oral hearing, that a convex cover would indeed serve to protect the internal sensor components in Mendelson-799, as Petitioner proposes. Tr. 64:6–65:5 (but noting that a flat cover would also protect, and would be less prone to scratches). Even if a convex cover seated against the skin may be more prone to scratches than a flat cover, this is just one of numerous tradeoffs that a person of ordinary skill in the art would consider, in determining whether the benefits of increased adhesion, signal strength, and protection outweigh the potential for a scratched cover. *Medichem*, 437 F.3d at 1165. We do not agree that the possibility of scratches alone would have dissuaded a person of ordinary skill in the art from the proposed modification, to achieve the benefits identified by Petitioner.

For the foregoing reasons, we are persuaded by Petitioner's contentions.

v. Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

4. Independent claims 10 and 20

Independent claims 10 and 20 consist of limitations that are substantially similar to elements [a]–[d] of claim 1. *Compare* Ex. 1001, 44:50–67, *with id.* at 45:35–47 *and id.* at 46:22–46. In asserting that claims 10 and 20 also would have been obvious over the combined teachings of Mendelson-799 and Ohsaki, Petitioner refers to the same arguments presented as to claim 1. *See* Pet. 45–50, 55–60.

Patent Owner does not separately address independent claims 10 and 20. *See generally* PO Resp.

We have examined the scope of claims 10 and 20 as well as Petitioner's unrebutted contentions concerning these two claims. Claim 10 is generally broader in scope than claim 1, but otherwise claims the same elements in the same configurations as examined above. *See* Pet. 45–50. One distinction is that "at least four detectors" must be "operably arranged on the planar surface of the substrate *in a pattern*." Ex. 1001, 45:35–47. Petitioner establishes how "the Mendelson-Ohsaki combination would have included twelve discrete detectors that are operably arranged on the planar surface of the sensor's substrate in a radially symmetric pattern around central light source 12." Pet. 49.

Claim 20 is also very similar to claim 1. *See id.* at 55–60. Claim 20 additionally requires "positioning the at least four detectors within *one or more spaces* formed by at least the substrate." Ex. 1001, 46:44–46. Petitioner also establishes how "the discrete detectors included within detectors 16 and 18 would have been positioned within spaces formed by the substrate, wall, and cover." Pet. 60 (citing Ex. 1003 ¶¶ 199–200).

Based on Petitioner's analysis and supporting testimony of Dr. Kenny, and for the same reasons discussed above, we are persuaded that Petitioner's cited evidence and reasoning demonstrates by a preponderance of the evidence that claims 10 and 20 would have been obvious over Mendelson-799 and Ohsaki. *See supra*.

5. Dependent claim 2

Dependent claim 2 depends from independent claim 1 and further recites: "The noninvasive optical physiological sensor of claim 1, wherein

the wall operably connects to the substrate on one side and operably connects to the cover on an opposite side." Ex. 1001, 45:1–3.

Petitioner primarily relies on its analysis of claim 1, citing to argument and evidence demonstrating how a person of ordinary skill in the art would understand that "the wall operably connects to the substrate on one side and operably connects to the cover on an opposite side," as claimed. Pet. 42 (citing Ex. 1003 ¶¶ 55–69, 78–138; Ex. 1012, code (57), 4:13–22, 7:25–8:13, 8:37–41, 9:22–10:30, Figs. 7, 8; Ex. 1009 ¶¶ 15, 17, 25, Figs. 1, 2, 4A, 4B).

Patent Owner argues that "Petitioner provides no independent analysis for this claim and instead refers back to analyses of claim 1." PO Resp. 41. Patent Owner also argues that, in the annotated figures, Petitioner relies on "a combination with cover and wall features that are unsupported and unexplained," and that Petitioner does not have support for placing a cover spanning the entire space above the substrate and for providing notches. *Id.* at 41–43.

We have addressed Patent Owner's concerns in our analysis above. As shown in the Petitioner's modified figures (*see* Pet. 41), the wall of the combined sensor surrounds the sensor components and is operably connected to the convex cover on the top and is operably connected to the planar substrate on the bottom, as claimed. Moreover, as discussed above regarding claim 1, Petitioner's proposed modifications to Mendelson-799 is not premised upon bodily incorporating Ohsaki's cover directly with Mendelson-799's sensor. *See In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973) ("Combining the teachings of references does not involve an ability to combine their specific structures.").

To the contrary, Petitioner proposes incorporating Ohsaki's teaching of a cover with a convex surface, not the precise cover and structure disclosed by Ohsaki. Ex. 1003 ¶ 88 ("And, consistent with Ohsaki's configuration, one of ordinary skill would have configured Mendelson '799's circumscribing wall to operably connect, on one side, to the planar substrate on which detectors 16 and 18 are arranged and, on an opposite side, to the convex cover.");*see also* Ex. 1012, code (57), 9:22–10:30, Fig. 7; Ex. 1009 ¶ 17, Fig. 2; *see also* Ex. 1047 ¶ 11 ("one of ordinary skill in the art would arrange for a convex cover based on the teaching of Ohsaki that was the right size to fit with the housing of Mendelson '799"). If Ohsaki's teaching is implemented in a manner that varies from the precise implementation of such a cover in Ohsaki, e.g., with a larger span or with notches, this is not a material deviation from Ohsaki's express teachings of using a cover with a convex surface to achieve specific benefits, e.g., improved adhesion and signal strength. Ex. 1009 ¶ 25; *see supra*; *see Lear Siegler, Inc. v. Aeroquip Corp.*, 733 F.2d 881, 889 (Fed. Cir. 1984) (explaining that a person of ordinary skill is not "compelled to adopt every single aspect of [a reference] without the exercise of independent judgment").

Accordingly, for the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 2 would have been obvious over the cited combination of references.

6. Dependent claims 3, 5, 6, 9, 11–18, 21–24, 29

Petitioner also contends that claims 3, 5, 6, 9, 11–18, 21–24, and 29 would have been obvious based on the same combination of prior art addressed above. These challenged claims all depend directly or indirectly

from independent claim 1, 10, or 20. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 29–62. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 139–211.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 41 ("The Petition fails to establish that independent claims 1, 10, and 20 are obvious over the cited references of Ground 1 and therefore fails to establish obviousness of any of the challenged dependent claims."); *see supra*.

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 3, 5, 6, 9, 11–18, 21–24, and 29 would have been obvious over the combined teachings of Mendelson-799 and Ohsaki, for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny.

7. Conclusion

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 1–3, 5, 6, 9–18, 20–24, and 29 would have been obvious over the cited combination of references.

E. Obviousness over the Combined Teachings of Mendelson-799, Ohsaki, and Schulz

Petitioner contends that claims 4, 18, and 24 of the ’553 patent would have been obvious over the combined teachings of Mendelson-799, Ohsaki, and Schulz. Pet. 62–74. Patent Owner disagrees and presents several arguments, including that “a POSITA would not have been motivated to combine Schulz with Mendelson ’799 and Ohsaki.” PO Resp. 43, 43–45; *see also generally* Sur-reply.

Based on our review of the parties’ arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of evidence that claims 4, 18, and 24 are unpatentable.

1. Overview of Schulz (Ex. 1013)

Schulz is a U.S. patent application publication titled “Pulse Oximetry Ear Sensor,” and discloses an ear sensor assembly including an emitter pad and a detector pad. Ex. 1013, codes (54), (57).

Figure 19C of Schulz is reproduced below.

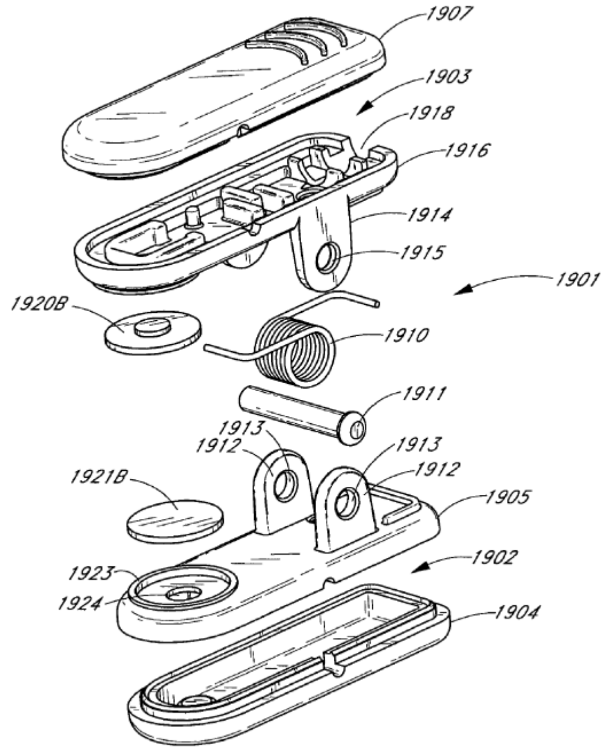


Figure 19C illustrates an exploded top perspective view of an ear sensor clip. *Id.* ¶ 31. Each sensor clip 1900 includes "opposingly positioned housings 1902 and 1903 that house one or more sensor optical components." *Id.* ¶ 65. Each housing includes respective inward facing shells 1905 and 1906.[7] *Id.* ¶ 65. "[I]nward facing shells 1905 and 1906 further include windows 1919 and 1924 that provide an aperture for transmission of optical energy to or from a tissue site. Translucent silicone material covers windows 1919 and 1924 providing lenses 1920 and 1921." *Id.* ¶ 67.

A "thin sheet of opaque material is located beneath window 1919 or 1924, and a window in the opaque material provides an aperture for transmission of optical energy to or from the tissue site." *Id.* ¶ 73. "The opaque material blocks light, and the window in the opaque material can be

[7] Figure 19C appears to label inward facing shell 1906 as 1916. *See id.* at Fig. 19B.

sized as needed to block the proper amount of light from entering the aperture to, for example, avoid saturation of the light detector." *Id.*

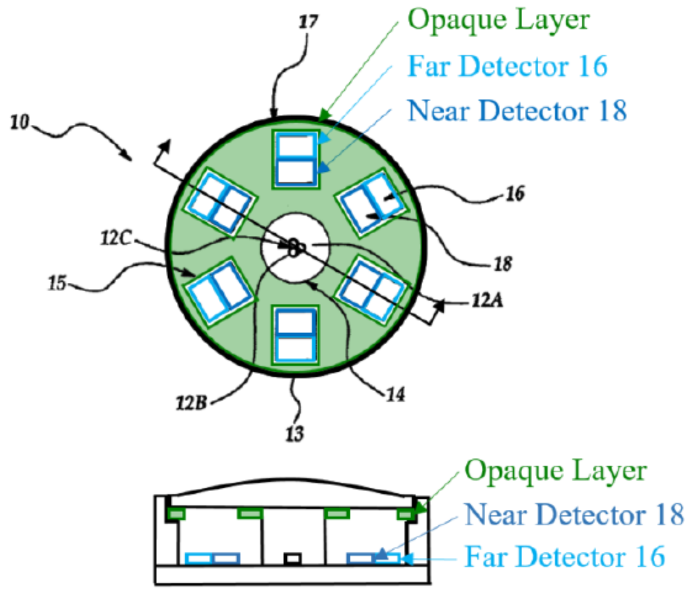
2. Dependent Claims 4, 18, and 24

Claim 4 requires "an opaque layer blocking light other than at one or more openings that allow light to pass through to at least one of the at least four detectors." Ex. 1001, 45:7–11. Claims 18 and 24 similarly require "one or more openings that allow light to pass through to the at least four detectors." *Id.* at 46:7–10, 60–63.

Petitioner's Disputed Contentions

Petitioner identifies teachings in the prior art references that teach the limitations of each of dependent claims 4, 18, and 24, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 65–74. More specifically, Petitioner contends that a person of ordinary skill in the art would have combined Mendelson-'799 and Ohsaki with Schulz to obtain additional benefits. *Id.* at 65. Petitioner contends "a POSITA would have recognized that the Mendelson-Ohsaki opaque wall would partially shield the detectors from ambient light, but would have understood from Schulz that additional measures could be taken to guard against saturation." *Id.* (citing Ex. 1019, 79, 86, 94). Petitioner relies on Schulz's sensor featuring a thin sheet of opaque material placed inside the sensor's housing beneath a lens with "a window in the opaque material provid[ing] an aperture for transmission of optical energy to or from the tissue site," as well as the sizeable opaque material blocking light from entering the aperture to avoid saturation of the light detector. *Id.* at 66 (quoting Ex. 1013 ¶ 73, Figs. 19A–19C).

Petitioner contends that a person of ordinary skill in the art would have been motivated to add a layer of opaque material to the Mendelson-Ohsaki sensor, and to size windows in the opaque material as appropriate, to avoid saturation of each of the sensor's detectors. *Id.* (citing Ex. 1003 ¶¶ 215–216; Ex. 1013 ¶ 73, Figs. 19A–19C). Petitioner argues that based upon the knowledge a person of skill in the art would possess, and based on Schulz's description, "Schulz's opaque layer limits errors by decreasing the angle of incidence to the photodiode to that enabled by the window included within the layer, and by otherwise preventing ambient light from reaching the photodiode." *Id.* at 67. Petitioner similarly argues that a person of ordinary skill in the art would have applied Schulz's teachings to pulse oximetry sensors featuring multiple photodiodes so that errors could be limited using an opaque layer with multiple windows, the windows being configured to decrease the angles of incidence to the photodiodes. *Id.* Relying on the annotated Figure 7 of Mendelson-'799 below, Petitioner argues that "Schulz would have motivated a POSITA to modify the Mendelson-Ohsaki combination to include an opaque layer that would have blocked light other than at windows corresponding to the sensor's photodiodes." *Id.* at 69.



Petitioner's annotated Figure 7 of Mendelson-799 and added sectional view depicting an additional "Opaque Layer" (illustrated in green) having windows. Pet. 70. According to Petitioner, "the Mendelson-Ohsaki-Schulz combination improves upon the Mendelson-Ohsaki combination by adding a well-known component, an opaque layer that blocks light other than at windows corresponding to the detectors, in order to 'avoid saturation' of the detectors." Pet. 70–71 (citing Ex. 1003 ¶ 222; Ex. 1013 ¶ 73). Thus, Petitioner concludes that "the Mendelson-Ohsaki-Schulz combination would have included an opaque layer blocking light other than at one or more openings that allow light to pass through to the twelve detectors." Pet. 71 (citing Ex. 1003 ¶¶ 55–72, 78–136, 213–222).

<u>Patent Owner's Arguments</u>

Patent Owner, relying on the testimony of Dr. Madisetti, argues that "a POSITA would *not* have been motivated to combine Schulz with Mendelson '799 and Ohsaki." PO Resp. 44 (citing Ex. 2004 ¶¶ 89–93). Patent Owner first argues aspects of Schulz individually. For example, Patent Owner argues that Schulz is directed to an ear sensor, but the

Mendelson-Ohsaki combination is not, and Mendelson-799 contrasts its reflectance sensor with transmission sensors attached on an earlobe. PO Resp. 44 (citing, e.g., Ex. 2004 ¶ 90). Patent Owner next contends that "there is no evidence over-saturation was a problem for the detectors in either Mendelson '799 or Ohsaki." *Id.*

Patent Owner further argues that a person of ordinary skill in the art would not have been motivated to modify Mendelson-799 as proposed because adding an opaque layer would *decrease* signal strength, especially for a reflectance pulse oximeter like Mendelson-799, which Patent Owner alleges has a weak signal already. PO Resp. 44–45 (citing, e.g., Ex. 2004 ¶¶ 91–93); Sur-reply 25–26. According to Patent Owner, a person of ordinary skill in the art would not have been motivated to add features that make an already weak signal even weaker, especially at "Petitioner's proposed wrist-worn sensor—a location where a POSITA would expect weak and noisy signals." Sur-reply 25–26. Further, "[n]othing in Schulz would have motivated a POSITA to add windows to Mendelson '799's sensor to block ambient light," whereas "other cited Mendelson references similarly place the sensor inside an opaque cover that would likewise suppress ambient light," according to Patent Owner. *Id.* at 26. Finally, Patent Owner asserts that a person of ordinary skill in the art would have expected the windows in Petitioner's proposed combination to prevent the necessary angular reflected light from reaching Mendelson-799's detectors, thereby making an already weak signal even weaker. PO Resp. 44–45 (citing Ex. 2004 ¶¶ 91–92).

<u>Analysis</u>

We have considered the parties' arguments and cited evidence, and we are persuaded by Petitioner's contentions. As discussed above, Schulz explicitly teaches that its opaque material and window "blocks light" and "avoid[s] saturation of the light detector." Ex. 1013 ¶ 73. Petitioner cites persuasive and well-supported evidence, including the testimony of its declarant, that a person of ordinary skill in the art would have been motivated to add such an arrangement to the sensor of Mendelson-799 to achieve this same disclosed benefit, i.e., to avoid saturation of Mendelson's detectors. *See, e.g.*, Ex. 1003 ¶¶ 215–216. For example, Dr. Kenny's testimony regarding the ability of an opaque material with windows to avoid saturation is supported by Schulz and by the Webster textbook, which discusses the importance of minimizing "light other than the optical signals of interest." *Id.* ¶ 217 (citing Ex. 1019, 76). We are persuaded by Petitioner's contentions and Dr. Kenny's testimony.

We do not agree with Patent Owner's argument that this modification would *decrease* signal strength. PO Resp. 44–45. We discern that Petitioner's proposed modification would not alter the signal of interest, i.e., the optical signal that passes from the emitter, through the user's tissue, and to the photodetectors. Rather, the cited evidence of record supports Petitioner's contention that the proposed modification would have blocked light *other than* that from the signal of interest, i.e., the emitter. *See, e.g.*, Ex. 1003 ¶ 221 ("Schulz would have motivated one of ordinary skill to modify the Mendelson-Ohsaki combination to include an opaque layer that would have blocked light other than at windows corresponding to the sensor's photodiodes."); Ex. 1013 ¶ 73 ("The opaque material blocks light,

and the window in the opaque material can be sized as needed to block the proper amount of light from entering the aperture to, for example, avoid saturation of the light detector."); *see also* Pet. Reply 24–26. Thus, we do not agree that the proposed modification would have decreased signal strength.

We have considered Patent Owner's similar argument that the proposed windows would have prevented certain angular reflected light from reaching Mendelson-799's detectors, thereby making an already weak signal even weaker. Sur-reply 27 (citing, e.g., Ex. 2004 ¶¶ 91–92). We do not find any support for this argument in Schulz. To the contrary, Schulz explains that "the window in the opaque material can be sized as needed to block the proper amount of light from entering the aperture to, for example, avoid saturation of the light detector." Ex. 1013 ¶ 73. Contrary to Patent Owner's argument, Schulz simply states that its window is sized to control the amount of light *that enters the aperture*; Schulz does not state where that light comes from, or that it only controls against light from the emitter.

We also do not agree with Patent Owner's argument that Petitioner has not shown that saturation was a problem for Mendelson-799's sensor. PO Resp. 44. Mendelson-799 need not identify a problem with saturation in order to be improved by the proposed modification. Indeed, Petitioner "does not need to show that there was a known problem with the prior art system." *Unwired Planet, LLC v. Google Inc.*, 841 F.3d 995, 1002–03 (Fed. Cir. 2016); *see also Sci. Plastic Prods., Inc. v. Biotage AB*, 766 F.3d 1355, 1359–61 (Fed. Cir. 2014); *Hologic, Inc. v. Minerva Surgical, Inc.*, 764 F. App'x 873, 880 (Fed. Cir. 2019). As expressly recognized in *KSR*, *any* art-recognized need or problem can provide a reason for combining claim

elements. *KSR*, 550 U.S. at 416. Here, Petitioner provides sufficient evidence to demonstrate that saturation was a known problem (*see, e.g.*, Ex. 1003 ¶¶ 216–220; Ex. 1019, 79; Ex. 1023, 11–12;[8] Ex. 1047 ¶¶ 63, 64) and that Schulz provided a readily-applicable technique to solve it (Ex. 1013 ¶ 73).

We also do not agree with Patent Owner's argument that Schulz and Mendelson-799 are incompatible because they obtain measurements at different locations. Mendelson-799 explains that its sensor type can be used in "multiple convenient locations on the body," and does not exclude use on a patient's ear or elsewhere. Ex. 1012, 2:15–21; *see also* Ex. 1019, 104 ("The idea of using skin reflectance spectrophotometry marked a significant advancement in the noninvasive monitoring of $Sa0_2$ from virtually any point on the skin surface."). Moreover, the proposed modification does not seek to bodily incorporate the references, one with the other. Rather, Petitioner clearly proposes modifying Mendelson-799 to include an opaque material with windows, as taught by Schulz, but plainly does not propose incorporating any other aspect of Schulz, such as its measurement location. *See* Pet. 47–49; *see also In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973) ("Combining the teachings of references does not involve an ability to combine their specific structures.").

[8] It is of no moment that this evidence is not identified as part of the asserted ground. PO Resp. 45. This evidence is cited by Dr. Kenny as support for his testimony, consistent with our rules. 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.").

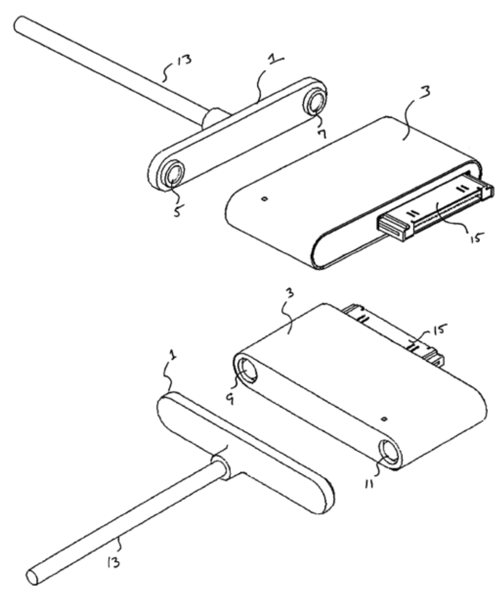
F. Obviousness over the Combined Teachings of Mendelson-799, Ohsaki, and Griffin

Petitioner contends that claim 25 of the ’553 patent would have been obvious over the combined teachings of Mendelson-799, Ohsaki, and Griffin. Pet. 74–79. Patent Owner disagrees and offers several reasons why a person of ordinary skill in the art would not have been motivated to combine Mendelson-799 and Ohsaki with Griffin. PO Resp. 46–47.

Based on our review of the parties’ arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of evidence that claim 25 is unpatentable.

1. Overview of Griffin (Ex. 1014)

Griffin is titled “Magnetic Connector” and it relates to a connector that “uses complimentary magnetic arrays and mating surfaces on its plug and receptacle,” as shown in Figures 1(a) and 1(b) reproduced below. Ex. 1014, codes (54), (57).



Figures 1(a) and 1(b) of Griffin show complimentary magnetic arrays and mating surfaces. Figures 1(a) and 1(b) also depict an electrical magnetic connector featuring "a plug having a plug magnet and plug face and a receptacle having a receptacle magnet and receptacle face." *Id.* at 1:54–2:18, 3:26–61, Figs. 1(a)–1(c).

Griffin's connection mechanism addresses problems that arise when, for example, "connectors are sometimes inadvertently decoupled," which can "result in a broken connector or even damage to the connected electronic device." *Id.* at 1:29–42. Griffins' plug and receptacle magnets allow for a quick and safe decouple when a sudden force is applied without resulting in any damage to the connector or the associated electronic device. *Id.* at 3:48–53, 5:26–38.

2. Dependent claim 25

Dependent claim 25 further requires: "a magnet configured to be used as a connecting mechanism." Ex. 1001, 4:64–67.

Undisputed Contentions

Griffin's teaching of a magnet configured to be used as a connecting mechanism is not disputed by Patent Owner. *See* PO Resp. 46 ("Griffin is a plug that 'uses complementary magnetic arrays and mating surfaces . . . to facilitate connection and disconnection of the ***connector***.'" (citing Ex. 1014, code (57)); Ex. 1003 ¶¶ 73–74.

Petitioner's Disputed Contentions

Petitioner proposes that a person of ordinary skill in the art would have been motivated to combine Mendelson-799 and Ohsaki with Griffin to obtain certain benefits. Pet. 77 (citing Ex. 1003 ¶¶ 246–247). Mendelson-799 identifies pulse oximeter 20 including "a control unit 21, which is

composed of an electronic block 22 including A/D and D/A converters connectable to the sensor 10." Pet. 76 (quoting Ex. 1012, 10:16–22). Petitioner contends that "Mendelson-799 does not explicitly describe the mechanism for connecting sensor 10 and electronic block 22 as a magnet but, in view of Griffin's disclosure, a POSITA would have found it obvious to implement that connection with a magnet configured to be used as a connecting mechanism." Pet. 77 (citing Ex. 1003 ¶ 248).

Petitioner contends that it was well known by the critical date that electrical connectors relying on a mechanical or friction fit to couple a plug to a receptacle were sometimes subject to inadvertent decoupling, and that such decoupling could result in broken connectors and devices. *Id.* (citing Ex. 1003 ¶ 249; Ex. 1014, 1:29–50). As such, Petitioner argues that a person of ordinary skill in the art would have understood that this problem could be solved with Griffin's magnetic connector, and integrating it into the Mendelson-799 and Ohsaki combination would have avoided problems that might arise from a sudden or forceful decoupling of the connection between sensor 10 and electronic block 22. Pet. 77–78 (citing Ex. 1003 ¶ 249; Ex. 1014, 1:54–2:18, 3:26–61, 5:26–38, Figs. 1(a)–1(c)).

<u>Patent Owner's Arguments</u>

Patent Owner contends that "[c]laim 25 is not obvious because a POSITA would not have been motivated to combine Griffin with Mendelson '799 and Ohsaki." PO Resp. 46 (citing Ex. 2004 ¶¶ 94–95). Patent Owner argues that Griffin uses magnetic arrays for connection to address the problem of inadvertently decoupled connectors, yet Petitioner's proposed combination of Mendelson-799 and Ohsaki would be a self-contained device attached to the user's wrist with a belt. *Id.* Thus, according to Patent

Owner, the person of ordinary skill in the art would not have been motivated to make the combination because "[t]he device has ***no*** attached cables that could be inadvertently decoupled," and "Petitioner never explains why a POSITA would have looked to Griffin to address decoupling issues when the combination of Mendelson '799 and Ohsaki has no cables to decouple." *Id.* (citing Ex. 2004 ¶ 95). Patent Owner contends that "Petitioner's combination has neither the need nor the opportunity for Griffin's magnetic connections to attached cables." Sur-reply 28.

Analysis

Petitioner has persuasively established why a person of ordinary skill in the art would have been motivated to modify the Mendelson-Ohsaki sensor such that the mechanism for connecting sensor 10 and electronic block 22 is implemented using a magnet, as taught by Griffin. *See* Pet. 76–78. Patent Owner's argument is premised on the proposed device always being "self-contained," and such a device never having the need to integrate a magnetic connector to avoid problems that might arise from a forceful decoupling. We disagree.

Patent Owner bases its argument on Ohsaki's device allegedly including "a display and electrical connections ***within the sensor body itself***." PO Resp. 46. Petitioner's description of the proposed combination, however, explains that Mendelson-799's pulse oximeter 20 includes "control unit 21, which is composed of an electronic block 22 including A/D and D/A converters connectable to the sensor 10." Pet. 76 (quoting Ex. 1012, 10:16–22). We agree with Petitioner that control unit 21 and sensor 10 would have been connected such that a person of ordinary skill in the art would have

been motivated to integrate Griffin's magnetic connection to avoid forceful decoupling. Pet. Reply 28 (citing e.g., Ex. 1003, 246–251).

Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of evidence that claim 25 is unpatentable.

G. Obviousness over the Combined Teachings of Mendelson-799, Ohsaki, and Mendelson-2006

Petitioner contends that claims 7 and 19 of the '553 patent would have been obvious over the combined teachings of Mendelson-799, Ohsaki, and Mendelson-2006. Pet. 79–96. Patent Owner disagrees and presents several arguments against the proposed combination. PO Resp. 47–50.

Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of evidence that claims 7 and 19 are unpatentable.

1. Overview of Mendelson-2006 (Ex. 1010)

Mendelson-2006 is a journal article titled "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," and discloses a wireless wearable pulse oximeter connected to a personal digital assistant ("PDA"). Ex. 1010, 1.[9]

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[9] Petitioner cites to the page numbers added to Exhibit 1010, rather than the native page numbering that accompanies the article. We follow Petitioner's numbering scheme.

Figure 1 of Mendelson-2006 is reproduced below.

Figure 1 illustrates a sensor module attached to the skin (top), and a photograph of a disassembled sensor module and receiver module (bottom). The sensor module includes an optical transducer, a stack of round printed circuit boards, and a coin cell battery. *Id.* at 2.

Figure 2 of Mendelson-2006 is reproduced below.

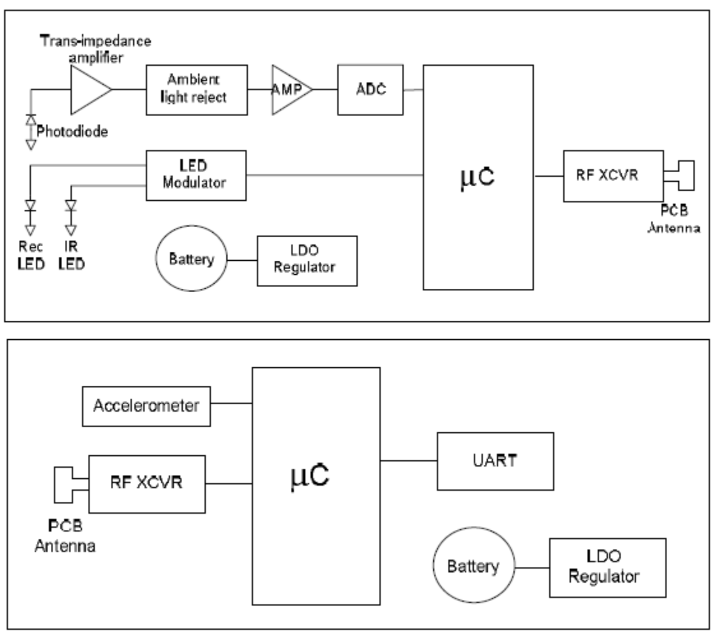

Figure 2 depicts a system block diagram of the wearable, wireless, pulse oximeter including the sensor module (top) and the receiver module (bottom). *Id.* The sensor module includes at least one light-emitting diode

("LED"), a photodetector, signal processing circuitry, an embedded microcontroller, and an RF transceiver. *Id.* at 1–2. Mendelson-2006 discloses that a concentric array of discrete photodetectors could be used to increase the amount of backscattered light detected by a reflectance type pulse oximeter sensor. *Id.* at 4. The receiver module includes an embedded microcontroller, an RF transceiver for communicating with the sensor module, and a wireless module for communicating with the PDA. *Id.* at 2.

As a PDA for use with the system, Mendelson-2006 discloses "the HP iPAQ h4150 PDA because it can support both 802.11b and Bluetooth™ wireless communication" and "has sufficient computational resources." *Id.* at 3. Mendelson-2006 further discloses that

> [t]he use of a PDA as a local terminal also provides a low-cost touch screen interface. The user-friendly touch screen of the PDA offers additional flexibility. It enables multiple controls to occupy the same physical space and the controls appear only when needed. Additionally, a touch screen reduces development cost and time, because no external hardware is required. . . . The PDA can also serve to temporarily store vital medical information received from the wearable unit.

Id.

The PDA is shown in Figure 3 of Mendelson-2006, reproduced below.

Figure 3 illustrates a sample PDA and its graphical user interface ("GUI"). *Id.* Mendelson-2006 explains that the GUI allows the user to interact with the wearable system. *Id.* "The GUI was configured to present the input and

output information to the user and allows easy activation of various functions." *Id.* "The GUI also displays the subject's vital signs, activity level, body orientation, and a scrollable PPG waveform that is transmitted by the wearable device." *Id.* For example, the GUI displays numerical oxygen saturation ("SpO_2") and heart rate ("HR") values. *Id.*

2. Dependent claims 7 and 19

Dependent claims 7 and 19 further require "a touch screen display," as well as "one or more processors" configured to receive data or signals from the four detectors, among other limitations. Ex. 1001, 45:18–28, 46:11–21.

Petitioner's Contentions

Petitioner first notes that the Mendelson-799 and Ohsaki combination would have included an optical sensor 10 for use in the proposed optical measurement device to measure a blood parameter. Pet. 81. Petitioner relies on the control unit of Mendelson-799 with electronic block 22 connectable to sensor 10, microprocessor 24 for analyzing measured data, and display 26 for presenting measurement results. Pet. 83. Petitioner contends that Mendelson-799 "describes a physiological monitoring device that includes both noninvasive optical physiological sensor 10 and pulse oximeter 20 with display 26 that is configured to utilize sensor 10." Pet. 83–84.

Petitioner observes that Mendelson-799 does not explicitly describe pulse oximeter 20's display 26 as a touch-screen display, but Petitioner contends that a person of ordinary skill in the art would have found it obvious to implement display 26 as a touch-screen display in light of the teachings of Mendelson-2006. Petitioner relies on the advantages of integrating a touch screen display described in Mendelson-2006, such as providing a low-cost touch screen interface and a simple GUI that presents

input and output information to the user to allow easy activation of various functions. Pet. 85. "To enable easy activation of various functions through a user-friendly interface similar to that described by Mendelson 2006, a POSITA would have found it obvious to implement pulse oximeter 20's display 26 as a touch-screen display." Pet. 86 (citing Ex. 1003 ¶¶ 265–268).

Petitioner next argues that a person of ordinary skill in the art would have found it obvious to enable Mendelson-799 and Ohsaki's sensor and pulse oximeter to communicate wirelessly with a PDA featuring a touch-screen display or mobile phone functionality in view of the teachings of the Mendelson-2006 disclosure. Pet. 86 (citing Ex. 1003 ¶ 269). Petitioner notes that at the time of invention, physiological sensor devices commonly communicated wirelessly with handheld computing devices. *Id.* Petitioner notes that Mendelson-2006's sensor module includes an "optical reflectance transducer" for measuring photoplethysmographic (PPG) signals, and the receiver module includes "an embedded microcontroller." Pet. 87 (quoting Ex. 1010, 1–2). Next, Petitioner shows how signals acquired by the Sensor Module of Mendelson-2006 are received by the embedded microcontroller which synchronously converts the corresponding output to various signals that are filtered by software to compute arterial oxygen saturation (SpO_2) and heart rate (HR) based on the relative amplitude and frequency content of the reflected PPG signals. *Id.* Petitioner relies on Mendelson-2006's disclosure of transmitting information acquired by the Sensor Module wirelessly via an RF link over a short range to a body-worn Receiver Module and data processed by the receiver module is transmitted wirelessly to a PDA. Pet. 88 (citing Ex. 1010, 2, Fig. 2). Petitioner contends that Mendelson-2006's PDA is a simple low-cost GUI that presents input and

output information to the user, which allows "easy activation of various functions" and a person of ordinary skill in the art would have recognized the benefit of adding these features into the Mendelson-799 and Ohsaki system. Pet. 88–89, 90 ("POSITA would have been motivated to wirelessly transmit information or data acquired or processed by sensor 10 and pulse oximeter 20 to a PDA featuring a touch-screen display and/or mobile phone functionality").

Patent Owner Contentions

Patent Owner, relying on the testimony of Dr. Madisetti, contends that a person of ordinary skill in the art "would have been led away from Petitioner's proposed combination as a whole" after reviewing the complete disclosure of Mendelson-2006. PO Resp. 48 (citing Ex. 2004 ¶¶ 96–102).

First, Patent Owner argues that Mendelson-2006's sensor uses a single detector ring and not multiple detectors as claimed. *Id.* (citing Ex. 1010, 1, 4). Further, the single photodetector ring increases the amount of backscattered light captured and also reduces power consumption, according to Patent Owner, such that a person of ordinary skill in the art "would have recognized that a single photodetector ring reduces power consumption because it maximizes the amount of light detected by eliminating the space between the individual detectors of Mendelson '799." *Id.*

Second, Mendelson-2006's device positions the sensor on the user's forehead and Patent Owner contends that this sensor would not be used on the back of the wrist due to signal strength and power concerns. *Id.* According to Patent Owner, "the resulting wrist-worn device would have low signal strength, would experience power management issues and

accordingly would be unsuitable for the wireless device discussed in Mendelson 2006." *Id.* at 49 (citing Ex. 2004 ¶ 100).

Third, and lastly, Patent Owner contends that "Mendelson 2006 further undermines a POSITA's motivation to add a protrusion based on Ohsaki," because "Ohsaki's board only prevents slipping due to movement if the sensor is positioned on the ***backside of the wrist***," and "the sensor should be placed on the ***forehead***, as Mendelson 2006 teaches." *Id.*

<u>Analysis</u>

We are persuaded that Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the testimony of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 261–307. Petitioner relies on Mendelson-2006 for teachings regarding wireless communications with a handheld device and a touch screen display. Pet. 79–96. Patent Owner's arguments do not pertain to the modifications proposed and, as such, are misplaced. *See* Pet. Reply 28 ("Mendelson-Ohsaki sensor is modified based on the teachings of Mendelson-2006 to (1) include a 'touch-screen display,' and (2) 'wirelessly transmit information . . . acquired or processed by sensor 10 and pulse oximeter 20 to a PDA'") (quoting Pet. 81–90); Ex. 1047 ¶ 72. The number of detectors in the sensor of Mendelson-2006 and where it is positioned on the user's body are not persuasive to whether a person of ordinary skill in the art would have been motivated to "implement display 26" of Mendelson-799 "as a touch-screen display," and to enable wireless transmission to a PDA. *See* Ex. 1047 ¶¶ 72–73.

Petitioner has persuasively established "why, in view of Mendelson-2006's disclosure, a POSITA would have found it obvious (1) 'to implement display 26 as a touch-screen display' (*see* Petition, 84–86), and (2) 'to

enable Mendelson-Ohsaki's sensor 10 and pulse oximeter 20 to communicate wirelessly with a PDA' (*see* Petition, 86–91)." Pet. Reply 29. We find Petitioner's reasons for the proposed combination persuasive, including the motivations to perform the modifications described in the Petition. *See* Pet. 84–86 (discussion of touch-screen display), 86–91 (discussion of wireless communication).

H. Obviousness over the Combined Teachings of Mendelson-799, Ohsaki, Mendelson-2006, and Griffin

Petitioner contends that claims 8 and 26–28 of the '553 patent would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Mendelson-2006, and Griffin. Pet. 97–100. Petitioner challenges claims 8 and 26–28, which include the magnetic connection limitation (discussed above) or the touch-screen display or mobile phone limitation (separately discussed above). We are persuaded by Dr. Kenny's testimony as to each limitation of these claims and the basis for combining the references as proposed. Ex. 1003 ¶¶ 310–323.

Patent Owner contends that this ground "fails for the same reasons as" as the prior two grounds discussed above. PO Resp. 50 ("a POSITA would not have been motivated to add Griffin to Mendelson '799 and Ohsaki because there are no external connections in the resulting combination" and "a POSITA reviewing Mendelson 2006 would not have been motivated to arrive at the claimed combination"). Thus, Patent Owner does not present any arguments for these claims other than those we have already considered above.

Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of evidence that claims 8 and 26–28 are unpatentable.

III. CONCLUSION

In summary:[10]

Claim(s) Challenged	35 U.S.C. §	References/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–3, 5, 6, 9–18, 20–24, 29	103	Mendelson-799, Ohsaki	1–3, 5, 6, 9–18, 20–24, 29	
4, 18, 24	103	Mendelson-799, Ohsaki, Schulz	4, 18, 24	
25	103	Mendelson-799, Ohsaki, Griffin	25	
7, 19	103	Mendelson-799, Ohsaki, Mendelson-2006	7, 19	
8, 26–28	103	Mendelson-799, Ohsaki, Mendelson-2006, Griffin	8, 26–28	
Overall Outcome			1–29	

[10] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–29 of the ’553 patent have been shown to be unpatentable;

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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U.S. DEPARTMENT OF COMMERCE
UNITED STATES PATENT AND TRADEMARK OFFICE

May 23, 2022

THIS IS TO CERTIFY that the attached document is a list of the papers that comprise the record before the Patent Trial and Appeal Board (PTAB) for the *Inter Partes* Review proceeding identified below.

APPLE INC.,

Petitioner,

v.

MASIMO CORPORATION,

Patent Owner.

Case No.: IPR2020-01537
United States Patent No.: 10,588,553 B2

By authority of the
DIRECTOR OF THE UNITED STATES PATENT AND TRADEMARK OFFICE

/s/ Mekbib Solomon
Certifying Officer

PROSECUTION HISTORY FOR *INTER PARTES* REVIEW NO.: IPR2020-01537

DATE	DESCRIPTION
08/31/2020	Petition for *Inter Partes* Review
08/31/2020	Petitioner's Power of Attorney
08/31/2020	Petitioner's Notice Ranking Petitions and Explaining Material Differences
09/17/2020	Notice of Filing Date Accorded
09/21/2020	Patent Owner's Mandatory Notices
11/04/2020	Petitioner's Updated Exhibit List
12/17/2020	Patent Owner's Notice of Waiver of Preliminary Response
03/02/2021	Decision - Institution of *Inter Partes* Review Proceeding
03/02/2021	Scheduling Order
03/16/2021	Patent Owner's Objections to Admissibility of Petitioner's Evidence Submitted Before Trial Institution
04/08/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
04/14/2021	Stipulation Modifying Due Dates
04/16/2021	Patent Owner's Motion for *Pro Hac Vice* Admission – Jeremiah Helm
04/16/2021	Patent Owner's Motion for *Pro Hac Vice* Admission – William Zimmerman
04/16/2021	Patent Owner's Updated Exhibit List
04/20/2021	Decision Granting Patent Owner's Motions for *Pro Hac Vice* Admission
04/20/2021	Patent Owner's Amended Notice of Deposition - Thomas W. Kenny
04/21/2021	Patent Owner's Updated Mandatory Notice
04/21/2021	Patent Owner's Supplemental Power of Attorney – W. Zimmerman and J. Helm
04/22/2021	Petitioner's Motion to Submit Supplemental Information
05/06/2021	Order Granting Petitioner's Motion to Submit Supplemental Information
05/14/2021	Petitioner's Submission of Supplemental Information
06/04/2021	Patent Owner's Response
06/11/2021	Petitioner's Objections to Evidence
07/19/2021	Petitioner's Notice of Deposition - Vijay K. Madisetti
08/27/2021	Petitioner's Reply to Patent Owner's Response
09/03/2021	Patent Owner's Objections to Evidence
09/09/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
09/13/2021	Petitioner's Updated Mandatory Notice
10/08/2021	Patent Owner's Sur-Reply
10/18/2021	Petitioner's Objections to Evidence
10/22/2021	Petitioner's Request for Oral Hearing
10/22/2021	Patent Owner's Oral Argument Request
10/28/2021	Patent Owner's Supplemental Mandatory Notices
11/01/2021	Order Setting Oral Argument
11/22/2021	Petitioner's Identification of Testimony
12/03/2021	Patent Owner's Demonstratives for Trial Hearing
12/03/2021	Petitioner's Updated Exhibit List

DATE	DESCRIPTION
01/06/2022	Oral Hearing Transcript
02/23/2022	Final Written Decision
04/12/2022	Notice of Appeal

Trials@uspto.gov
571-272-7822

Paper 43
Date: February 23, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

IPR2020-01537
Patent 10,588,553 B2

Before GEORGE R. HOSKINS, ROBERT L. KINDER, and AMANDA F. WIEKER, *Administrative Patent Judges*.

KINDER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

Apple Inc. ("Petitioner") filed a Petition requesting an *inter partes* review of claims 1–29 ("challenged claims") of U.S. Patent No. 10,588,553 B2 (Ex. 1001, "the '553 patent"). Paper 3 ("Pet."). Masimo Corporation ("Patent Owner") waived filing a Preliminary Response. Paper 8. We instituted an *inter partes* review of all challenged claims 1–29 on all asserted grounds of unpatentability, pursuant to 35 U.S.C. § 314. Paper 9 ("Inst. Dec.").

After institution, Patent Owner filed a Response (Paper 24, "PO Resp.") to the Petition, Petitioner filed a Reply (Paper 27, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 31, "Sur-reply").[1] An oral hearing was held on December 7, 2021, and a transcript of the hearing is included in the record. Paper 41 ("Tr.").

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, Petitioner has met its burden of showing, by a preponderance of the evidence, that challenged claims 1–29 of the '553 patent are unpatentable.

B. Related Proceedings

Masimo Corporation v. Apple Inc., Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

Apple Inc. v. Masimo Corporation, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims 1–29 of the '553 patent);

[1] After the Sur-reply was filed, we authorized Petitioner to file an Identification of Testimony. Paper 37.

Apple Inc. v. Masimo Corporation, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2); and

Apple Inc. v. Masimo Corporation, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2).

Pet. 3; Paper 5, 3.

Patent Owner further identifies certain pending patent applications, as well as other issued and abandoned applications, that claim priority to, or share a priority claim with, the ’553 patent. Paper 5, 1–2.

C. The ’553 Patent

The ’553 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on March 17, 2020, from U.S. Patent Application No. 16/534,949, filed August 7, 2019. Ex. 1001, codes (21), (22), (45), (54). The ’553 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The '553 patent relates to noninvasive methods and devices for measuring various blood constituents or analytes. *Id*. at code (57). The '553 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:38–40. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:29–35, 2:64–65. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:45–48.

Figure 1 of the '553 patent is reproduced below.

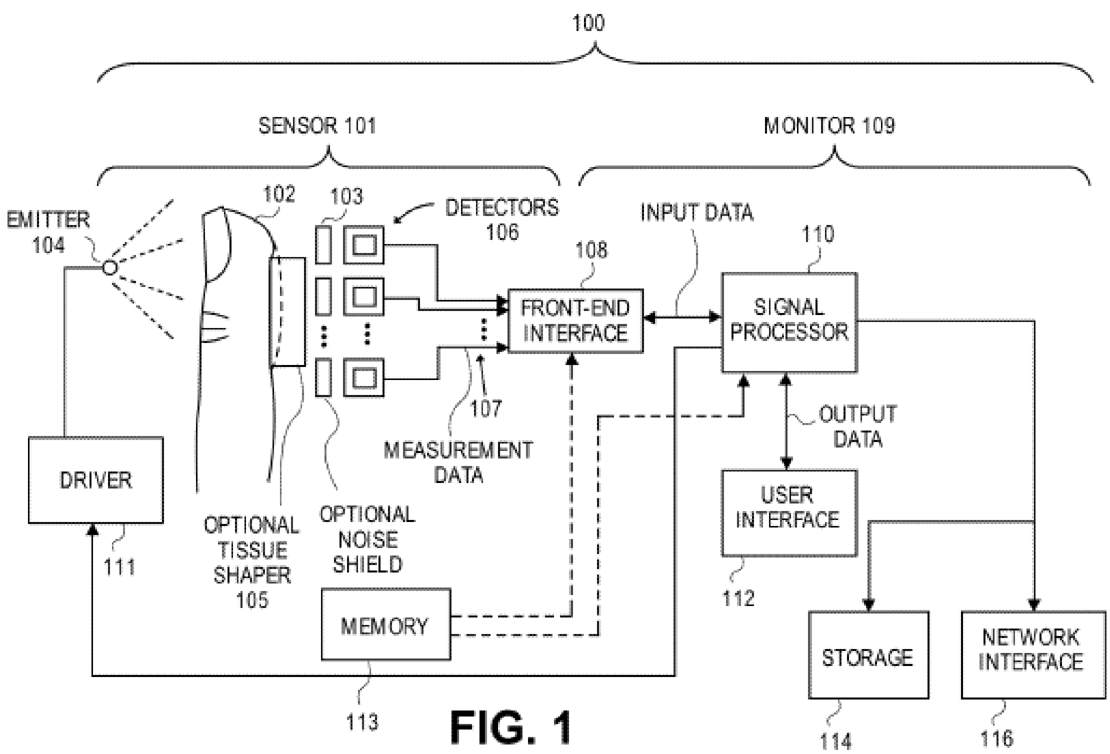

FIG. 1

Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:47–58. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* at 11:59–63. Emitters 104 emit light that is attenuated or reflected by the patient's tissue at measurement site 102. *Id.*

at 14:3–7. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light, detectors 106 output detector signals 107 to monitor 109 through front-end interface 108 and detectors 106 can be implemented using photodiodes. *Id.* at 14:7–10, 14:26–32. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 11:2–14.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:16–18. "[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals received from the detectors." *Id.* at 15:21–24. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:46–56. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 15:60–16:11.

The '553 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate sensor devices.

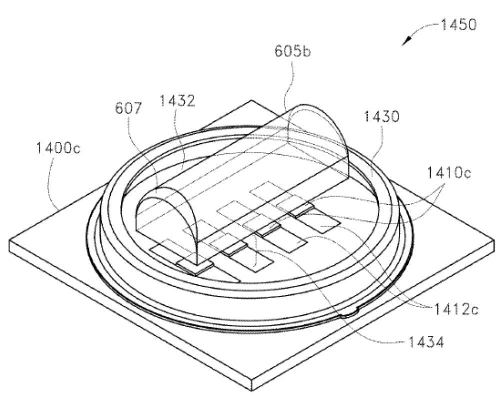

FIG. 14D

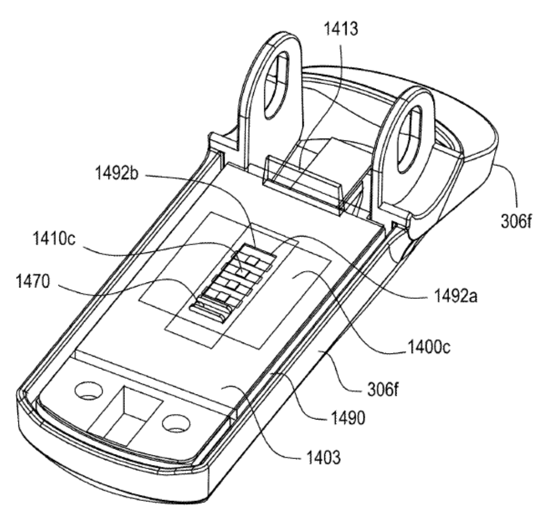

FIG. 14F

Figure 14D (left) illustrates portions of a detector submount and Figure 14F (right) illustrates portions of a detector shell. *Id.* at 6:44–47. As shown in Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 35:36–39, 36:30–37. Figure 14F illustrates a detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 37:9–25. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* Alternatively, cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:47–49.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.

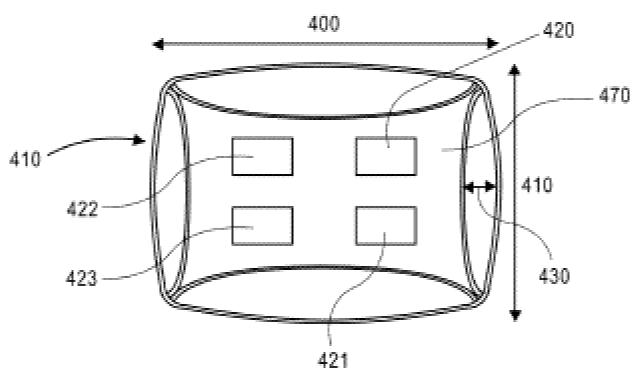

FIG. 4A

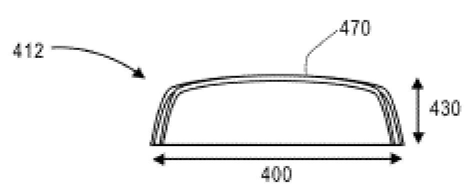

FIG. 4B

Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:18–24. "[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site." *Id.* "For example, . . . measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site." *Id.* at 23:39–43. The measurement site contact area may include

windows 420–423 that "mimic or approximately mimic a configuration of, or even house, a plurality of detectors." *Id.* at 23:49–63.

D. Illustrative Claim

Of the challenged claims, claims 1, 10, and 20 are independent. Claim 1 is illustrative and is reproduced below.

> 1. A noninvasive optical physiological sensor comprising:
>
> [a] a plurality of emitters configured to emit light into tissue of a user;
>
> [b] at least four detectors, wherein at least one of the at least four detectors is configured to detect light that has been attenuated by tissue of the user, and wherein the at least four detectors are arranged on a substrate;
>
> [c] a wall configured to circumscribe at least the at least four detectors; and
>
> [d] a cover configured to be located between tissue of the user and the at least four detectors when the noninvasive optical physiological sensor is worn by the user, wherein the cover comprises a single protruding convex surface operable to conform tissue of the user to at least a portion of the single protruding convex surface when the noninvasive optical physiological sensor is worn by the user, and wherein the wall operably connects to the substrate and the cover.

Ex. 1001, 44:50–67 (bracketed identifiers a–d added). Independent claims 10 and 20 include limitations substantially similar to limitations [a]–[d] of claim 1. *Id.* at 45:35–47, 46:22–46.

E. Applied References

Petitioner relies upon the following references:

> Aizawa, U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002 (Ex. 1006, "Aizawa");
>
> Inokawa et al., Japanese Patent Application Publication No. 2006-296564 A, filed April 18, 2005, published November 2, 2006 (Ex. 1007, "Inokawa");[2]
>
> Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1009, "Ohsaki");
>
> Y. Mendelson et al., "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," Proceedings of the 28th IEEE EMBS Annual International Conference, 912–915 (2006) (Ex. 1010, "Mendelson-2006"); and
>
> Sherman, U.S. Patent No. 4,941,236, filed July 6, 1989, issued July 17, 1990 (Ex. 1011, "Sherman").

Pet. 9.

Petitioner also submits, *inter alia*, a Declaration of Dr. Thomas W. Kenny, Ph.D. (Ex. 1003) and a Second Declaration of Dr. Kenny (Ex. 1047). Patent Owner submits, *inter alia*, the Declaration of Dr. Vijay K. Madisetti (Ex. 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madisetti, including from this proceeding and others. Exs. 1041–1043, 2006–2009, 2027.

[2] Petitioner relies on a certified English translation of Inokawa (Ex. 1008). Ex. 1008, 24. In this Decision, we also refer to the translation.

F. Asserted Grounds of Unpatentability

We instituted an *inter partes* review based on the following grounds. Inst. Dec. 9, 27.

Claims Challenged	35 U.S.C. §	References/Basis
1–6, 9–18, 20–24, 29	103	Aizawa, Inokawa, Ohsaki
7, 19	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006
8, 25–28	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006, Sherman

II. DISCUSSION

A. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2019). Petitioner submits that no claim term requires express construction. Pet. 7. Patent Owner submits that claim terms should be given their ordinary and customary meaning, consistent with the Specification. PO Resp. 8.

We agree that no claim terms require express construction. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

B. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103(a) if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said

subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness.[3] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must support its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

Petitioner identifies the appropriate level of skill in the art as that possessed by a person having "a Bachelor of Science degree in an academic

[3] The parties have not presented objective evidence of non-obviousness.

discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information." Pet. 7 (citing Ex. 1003 ¶¶ 1–18, 20–21). "Additional education in a relevant field or industry experience may compensate for one of the other aspects of the . . . characteristics stated above." *Id.*

Patent Owner makes several observations regarding Petitioner's identified level of skill in the art but, "[f]or this proceeding, [Patent Owner] nonetheless applies Petitioner's asserted level of skill." PO Resp. 8–9.

We adopt Petitioner's assessment as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

D. Obviousness over the Combined Teachings of Aizawa, Inokawa, and Ohsaki

Petitioner contends that claims 1–6, 9–18, 20–24, and 29 of the '553 patent would have been obvious over the combined teachings of Aizawa, Inokawa, and Ohsaki. Pet. 9–74; *see also* Pet. Reply 1–29. Patent Owner disagrees. PO Resp. 10–54; *see also* Sur-reply 1–24.

Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of the evidence that claims 1–6, 9–18, 20–24, and 29 are unpatentable.

1. Overview of Aizawa (Ex. 1006)

Aizawa is a U.S. patent application publication titled "Pulse Wave Sensor and Pulse Rate Detector," and discloses a pulse wave sensor that detects light output from a light emitting diode and reflected from a patient's artery. Ex. 1006, codes (54), (57).

Figure 1(a) of Aizawa is reproduced below.

FIG. 1 (a)

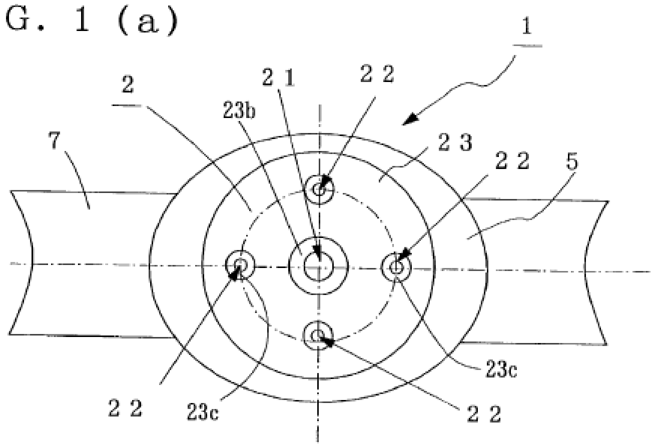

Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode ("LED") 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses that, "to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased." *Id.* ¶ 32, Fig. 4(a). "The same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector 22." *Id.* ¶ 33.

Figure 1(b) of Aizawa is reproduced below.

FIG. 1 (b)

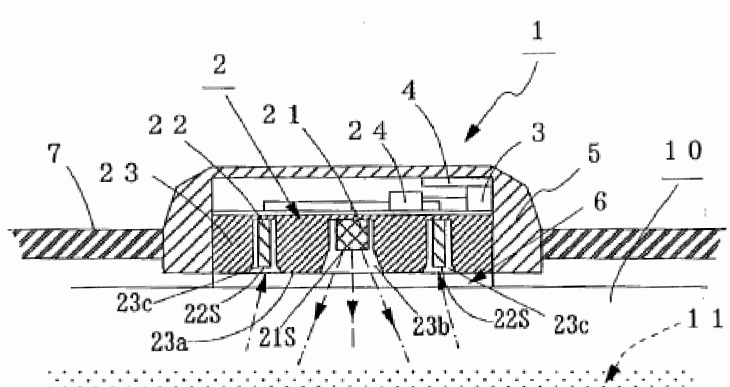

Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an "unshown display." *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.*

Aizawa discloses that LED 21 and photodetectors 22 "are stored in cavities 23b and 23c formed in the detection face 23a" of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a "is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a." *Id.* Aizawa discloses that "a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting face 21s of the light emitting diode 21 faces down (on the wrist 10 side)." *Id.* ¶ 26. Furthermore, "the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10. Thereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶¶ 26, 34.

2. Overview of Inokawa (Exs. 1007, 1008)

Inokawa is a Japanese published patent application titled "Optical Vital Sensor, Base Device, Vital Sign Information Gathering System, and Sensor Communication Method," and discloses a pulse sensor device. Ex. 1008 ¶ 6.

Figure 1 of Inokawa is reproduced below.

(FIG. 1)

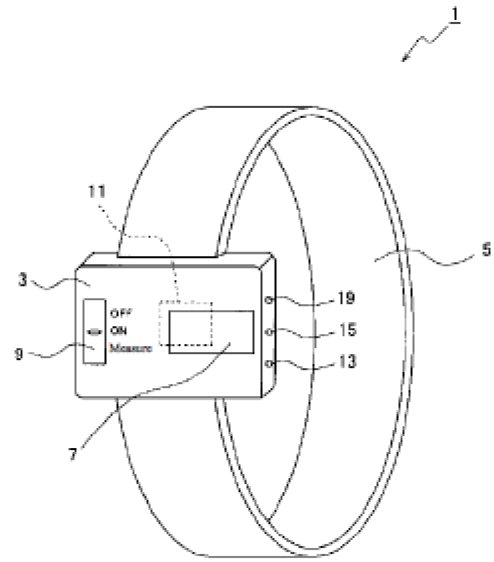

Figure 1 illustrates a schematic view of a pulse sensor. *Id.* ¶ 56. Pulse sensor 1 includes box-shaped sensor unit 3 and flexible annular wristband 5. *Id.* ¶ 57. Sensor unit 3 includes a top surface with display 7 and control switch 9, and a rear surface (sensor-side) with optical device component 11 for optically sensing a user's pulse. *Id.*

Figure 2 of Inokawa is reproduced below.

(FIG. 2)

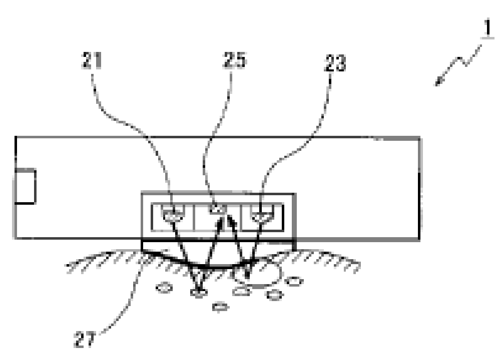

Figure 2 illustrates a schematic view of the rear surface of the pulse sensor. *Id.* ¶ 58. The rear-side (sensor-side) of pulse sensor 1 includes a pair of

light-emitting elements, i.e., green LED 21 and infrared LED 23, as well as photodiode 25 and lens 27. *Id.* In various embodiments, Inokawa discloses that the sensor-side lens is convex. *See id.* ¶¶ 99, 107. Green LED 21 is used to sense "the pulse from the light reflected off of the body (i.e.[,] change in the amount of hemoglobin in the capillary artery)," and infrared LED 23 is used to sense body motion from the change in reflected light. *Id.* ¶ 59. The pulse sensor stores this information in memory. *Id.* ¶ 68. To read and store information, the pulse sensor includes a CPU that "performs the processing to sense pulse, body motion, etc. from the signal . . . and temporarily stores the analysis data in the memory." *Id.* ¶ 69.

Figure 3 of Inokawa is reproduced below.

(FIG. 3)

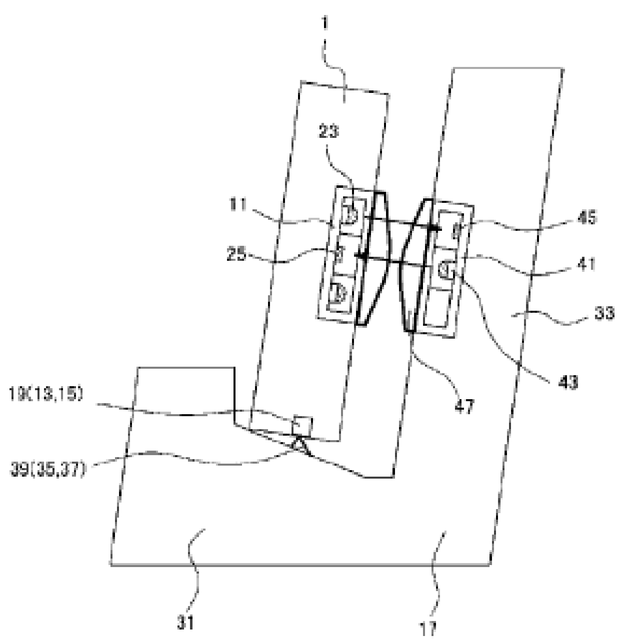

Figure 3 illustrates a schematic view of a pulse sensor mounted to a base device. *Id.* ¶ 60. Pulse sensor 1 is depicted as mounted to base device 17, which "is a charger with communication functionality." *Id.* When so mounted, sensor optical device component 11 and base optical device

component 41 face each other in close proximity. *Id.* ¶ 66. In this position, pulse sensor 1 can output information to the base device through the coupled optical device components. *Id.* ¶ 67. Specifically, the pulse sensor CPU performs the controls necessary to transmit pulse information using infrared LED 23 to photodetector 45 of base device 17. *Id.* ¶¶ 67, 70, 76. In an alternative embodiment, additional sensor LEDs and base photodetectors can be used to efficiently transmit data and improve accuracy. *Id.* ¶ 111.

3. Overview of Ohsaki (Ex. 1009)

Ohsaki is a U.S. patent application publication titled "Wristwatch-type Human Pulse Wave Sensor Attached on Back Side of User's Wrist," and discloses an optical sensor for detecting a pulse wave of a human body. Ex. 1009, code (54), ¶ 3. Figure 1 of Ohsaki is reproduced below.

FIG. 1

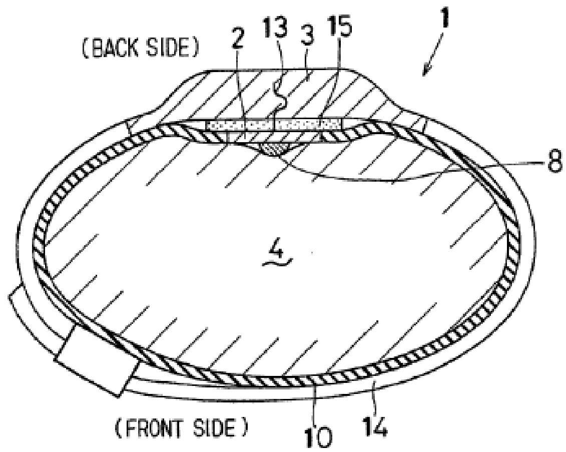

Figure 1 illustrates a cross-sectional view of pulse wave sensor 1 attached on the back side of user's wrist 4. *Id.* ¶¶ 12, 16. Pulse wave sensor 1 includes detecting element 2 and sensor body 3. *Id.* ¶ 16.

Figure 2 of Ohsaki, reproduced below, illustrates further detail of detecting element 2.

FIG. 2

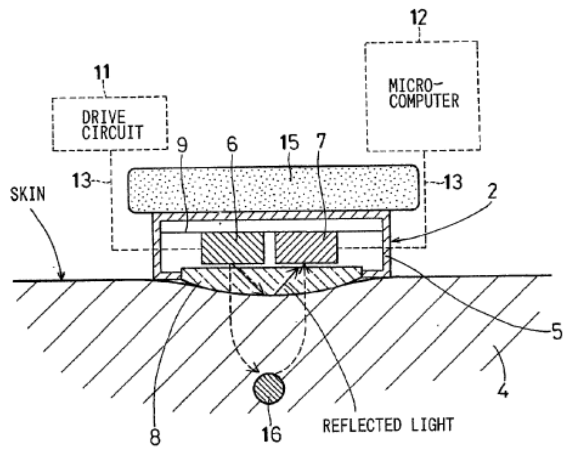

Figure 2 illustrates a mechanism for detecting a pulse wave. *Id.* ¶ 13. Detecting element 2 includes package 5, light emitting element 6, light receiving element 7, and translucent board 8. *Id.* ¶ 17. Light emitting element 6 and light receiving element 7 are arranged on circuit board 9 inside package 5. *Id.* ¶¶ 17, 19.

"[T]ranslucent board 8 is a glass board which is transparent to light, and attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8." *Id.* ¶ 17. "[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin," preventing detecting element 2 from slipping off the detecting position of the user's wrist. *Id.* ¶ 25. By preventing the detecting element from moving, the convex surface suppresses "variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin." *Id.* Additionally, the convex surface prevents penetration by "noise such as disturbance light from the outside." *Id.*

Sensor body 3 is connected to detecting element 2 by signal line 13. *Id.* ¶ 20. Signal line 13 connects detecting element 2 to drive circuit 11, microcomputer 12, and a monitor display (not shown). *Id.* Drive circuit 11 drives light emitting element 6 to emit light toward wrist 4. *Id.* Detecting element 2 receives reflected light which is used by microcomputer 12 to calculate pulse rate. *Id.* "The monitor display shows the calculated pulse rate." *Id.*

4. Independent Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Aizawa, Inokawa, and Ohsaki. Pet. 16–45. Below, we set forth how the combination of prior art references teaches or suggests the claim limitations that are not disputed by the parties. For those limitations and reasons for combining the references that are disputed, we examine each of the parties' contentions and then provide our analysis.

i. "A noninvasive optical physiological sensor comprising:"

The cited evidence supports Petitioner's undisputed contention that Aizawa satisfies the subject matter of the preamble.[4] Pet. 32; *see, e.g.*, Ex. 1006 ¶ 2, code (57) ("pulse wave sensor for detecting a pulse wave by detecting light output from a light emitting diode and reflected from the artery of a wrist of a subject"), Fig. 2 (depicting structure of optical pulse wave sensor); *see also* Ex. 1003 ¶¶ 95–99.

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[4] Whether the preamble is limiting need not be resolved because Petitioner shows sufficiently that the preamble's subject matter is satisfied by the art.

ii. "[a] a plurality of emitters configured to emit light into tissue of a user"

Petitioner's Undisputed Contentions

Petitioner contends that Aizawa discloses an emitter—LED 21—and also states that, in certain embodiments, multiple LEDs may be employed. Pet. 16, 33. Patent Owner does not dispute this contention, and we agree. *See* Ex. 1006 ¶¶ 23 ("LED 21"), 32 ("The arrangement of the light emitting diode 21 and the photodetectors 22 is not limited to this."). For example, Aizawa explains that "[t]he same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector." *Id.* ¶ 33.

Petitioner also contends that Inokawa teaches a sensor with two LEDs–a green LED to sense pulse and an infrared LED to sense body motion. Pet. 18, 34. Petitioner also contends that when Inokawa's sensor is mounted on a base device, the infrared LED also is used to wirelessly transmit vital sign information to the base device. *Id.* at 18, 21, 34. Patent Owner does not dispute these contentions, and we agree with Petitioner. Inokawa teaches a pair of LEDs 21, 23, where "the basic function of the S-side green LED 21 is to sense the pulse from the light reflected off of the body . . ., while the S-side infrared LED 23 serves to sense body motion from the change in this reflected light." Ex. 1008 ¶¶ 58–59. Inokawa also explains that "vital sign information stored in the memory 63 [of the sensor], such as pulse and body motion, is transmitted to the base device 17 using the S-side infrared LED 23 of the pulse sensor 1 and the B-side PD 45 of the base device 17," such that "there is no need to use a special wireless communication circuit or a communication cable." *Id.* ¶¶ 76–77.

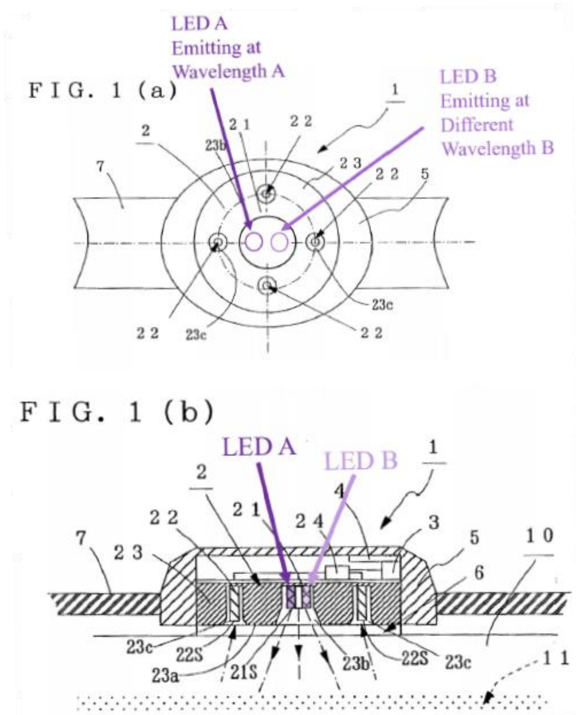
Petitioner's Disputed Contentions

Moreover, Petitioner contends that a person of ordinary skill in the art would have been motivated to modify Aizawa to "include an additional LED as taught by Inokawa to improve the detected pulse wave by distinguishing between blood flow detection and body movement." Pet. 17, 18–24, 33–34; Ex. 1003 ¶¶ 69, 108. Petitioner contends that "Aizawa-Inokawa would have utilized two LEDs that emit two different wavelengths," such that "Aizawa's sensor would have been improved through the implementation of a separate LED to account for motion load." Pet. 20. According to Dr. Kenny, "one of ordinary skill would have recognized that this would improve Aizawa's sensor by enabling it to account for motion load through use of the second LED, by detecting and recording body motion in addition to blood flow." Ex. 1003 ¶¶ 76, 110.

As a second and independent motivation, Petitioner contends that such a modification also would have provided "additional functionality, including that of [a] wireless communication [method]," which would have "eliminat[ed] problems associated with a physical cable, and that does not require a separate RF circuit, as taught by Inokawa." Pet. 21–24. Petitioner contends that although Aizawa discloses data transmission, Aizawa "is silent about how such transmission would be implemented." Pet. 23. According to Petitioner, a skilled artisan would have recognized that Aizawa's LED could have been used for wireless data communication with a personal computer to eliminate problems associated with a physical cable, and, as taught by Inokawa, without requiring a separate RF circuit, which "would result in enhanced accuracy of the transmitted information." Pet. 23–24 (citing Ex. 1003 ¶¶ 68–83). According to Dr. Kenny, "as one of ordinary

skill would have recognized, the LEDs provided on the sensor can be used not only to detect pulse rate, but also to 'accurately, easily, and without malfunction' transmit sensed data to a base station." Ex. 1003 ¶¶ 112, 78.

To illustrate its proposed modification, Petitioner includes annotated and modified views of Aizawa's Figures 1(a) and 1(b), reproduced below. Pet. 19–20; *see also id.* at 33–34 (similar figures); Ex. 1003 ¶ 75.



Petitioner's annotated and modified figures depict the sensor of Aizawa with an added "LED B" (illustrated in light purple), as Petitioner contends would have been rendered obvious by Inokawa. Pet. 19–20, 23–24, 33–35; *see also* Ex. 1003 ¶¶ 72–83, 109–119.

<u>Patent Owner's Arguments</u>

Patent Owner disputes Petitioner's contentions regarding the obviousness of modifying Aizawa to include two emitters. *See* PO Resp. 48–54; Sur-reply 24–26.

First, Patent Owner argues that neither Aizawa nor Inokawa discloses a device with both multiple detectors *and* multiple emitters in the *same* sensor, because Aizawa's embodiments have either a single emitter and multiple detectors (e.g., Ex. 1006, Fig. 1(a)) or multiple emitters and a single detector (e.g., *id.* ¶ 33), and Inokawa discloses multiple emitters and a single detector (e.g., Ex. 1008, Fig. 2). *See* PO Resp. 48–49 (citing, e.g., Ex. 1006 ¶ 33, Figs. 1, 2, 4, 5; Ex. 1008 ¶ 58, Fig. 2; Ex. 2004 ¶¶ 100–102). Patent Owner concludes, therefore, that a person of ordinary skill in the art would not have added a second emitter to Aizawa, when Aizawa already discloses an embodiment with multiple LEDs, i.e., an embodiment with only a single detector. PO Resp. 49 (citing, e.g., Ex. 2004 ¶ 103).

Second, Patent Owner argues that the evidence does not support either of Petitioner's two proffered motivations for modifying Aizawa to include two emitters. *Id.* As to the first motivation (to measure body movement using a second emitter), Patent Owner asserts that Dr. Kenny erroneously testifies that Aizawa cannot do this with its single emitter. *Id.* at 49–50 (citing, e.g., Ex. 1006 ¶ 15; Ex. 2007, 400:7–401:10; Ex. 2004 ¶ 104). Patent Owner argues that "Dr. Kenny incorrectly believed Aizawa's sensor attempts to prevent motion rather than account for it," yet, "Aizawa expressly states that it already provides a 'device for computing the amount of motion load from the pulse rate' based on its measured data." *Id.* at 50 (quoting Ex. 1006 ¶ 15) (emphasis omitted). Thus, Patent Owner contends that the proposed motivation would not realize an improvement over Aizawa alone. *Id.*; Ex. 2004 ¶ 84.

As to Petitioner's second motivation (to enable transmission of data to a base device using an optical communication link), Patent Owner argues

that "Aizawa ***already*** includes a wireless transmitter . . . so Aizawa does not need to incorporate Inokawa's base-device [optical] data transmission arrangement." PO Resp. 51 (citing, e.g., Ex. 1006 ¶¶ 23, 28, 35; Ex. 2004 ¶¶ 105–106). Indeed, Patent Owner argues "Dr. Kenny acknowledged Aizawa does not indicate there are any problems with Aizawa's form of data transmission." *Id.* (citing Ex. 2007, 409:13–410:2). Patent Owner further argues that "Aizawa's goal is 'real-time measuring' with the transmitter 'transmitting the measured pulse rate data to a display'" but that "Inokawa's data transfer approach does not allow real-time display of measurements." *Id.* (citing, e.g., Ex. 1006 ¶¶ 4, 15; Ex. 1008 ¶¶ 70, 74; Ex. 2004 ¶ 107). Patent Owner contends that "[t]ransforming Aizawa's sensor to employ a base-device transmitter eliminates the ability to take and display real-time measurements, one of Aizawa's stated goals, while increasing power consumption and cost." *Id.* at 51–52.

Patent Owner insists Inokawa does not aid Petitioner's case, because Inokawa discloses the benefits of using a second emitter in only two situations, i.e., first, to avoid the risk of contact failure in a "cable" communication and, second, to avoid use of a "dedicated wireless communication circuit," whereas "Aizawa ***already*** incorporates a transmitter into its design." *Id.* at 52 (citing, e.g., Ex. 1008 ¶ 4; Ex. 1006 ¶¶ 16, 23, 28; Ex. 2004 ¶ 108).

Third, Patent Owner accuses Petitioner and Dr. Kenny of overlooking further complications that would ensue from modifying Aizawa to have two emitters. *Id.* at 53. Patent Owner argues that Dr. Kenny overlooked how placing "two LEDs in close proximity may cause thermal interference that could create significant issues for sensor performance," and would require

"structural changes" to Aizawa's configuration. *Id.* (citing, e.g., Ex. 2004 ¶¶ 109–110; Ex. 1019, 59–60; Ex. 2007, 379:17–21, 384:16–388:16). Patent Owner also argues that "Petitioner widened Aizawa's emitter cavity to accommodate the extra LED with no [] explanation or recognition of this change," which could impact optical performance of the device. *Id.* at 53–54 (citing, e.g., Ex. 2004 ¶¶ 109–111).

<u>Petitioner's Reply</u>

Petitioner reiterates that a person of ordinary skill in the art would have "added a second emitter to Aizawa operating at a different wavelength from the first, 'to improve the detected pulse wave by distinguishing between blood flow detection and body movement.'" Pet. Reply 29. Petitioner asserts that Aizawa "is silent on whether it uses the computed motion load to improve the detection signal" and thereby provide a "more reliable" pulse reading, which is Petitioner's asserted improvement to Aizawa. *Id.* at 29–30 (citing, e.g., Ex. 1003 ¶¶ 80, 113; Ex. 2007, 401:11–402:4; Ex. 1047 ¶ 60). Moreover, Petitioner contends that "[b]ecause different wavelengths have different sensitivities to pulse and body motion, collecting two separate signals allows noise arising from body motion to be better isolated and accounted for." *Id.* at 30 (citing Ex. 1047 ¶ 60).

Concerning Petitioner's second motivation (improving data transmission accuracy), Petitioner maintains that Inokawa's use of two emitters having different wavelengths to upload data to a base station using optical communication advantageously improves the accuracy of the transmission by providing checksum information. *Id.* (citing, e.g., Ex. 1003 ¶ 80; Ex. 2007, 407:7–408:20, 416:5–15; Ex. 1047 ¶¶ 61–62).

As to the "other complications" that Patent Owner alleges would result from the proposed modification, Petitioner asserts "such minor issues are 'part of what [a person of ordinary skill in the art] would bring . . . to the problem and would know how to make the changes needed.'" Pet. Reply 30–31 (quoting Ex. 2007, 384:8–388:12) (citing Ex. 1047 ¶ 63).

<u>Patent Owner's Sur-reply</u>

Concerning Petitioner's first motivation, Patent Owner argues that Inokawa's disclosure is just as sparse as Aizawa's disclosure regarding how to use optical data to measure body movement. Sur-reply 24 (citing Ex. 1008 ¶ 59). Patent Owner also asserts that "Petitioner cites nothing in Inokawa that suggests" that Inokawa's two emitter data gathering is more reliable or otherwise superior to Aizawa's single emitter data gathering. *Id.* at 24–25.

Concerning Petitioner's second motivation, Patent Owner argues that the proposed modification eliminates Aizawa's ability to conduct "***real-time*** collection and display of physiological measurements—a key goal of Aizawa's system." *Id.* at 25.

Patent Owner also faults Petitioner for not specifying how a person of ordinary skill in the art would have solved the alleged "additional costs, energy use, and thermal problems" that would ensue from using two emitters in the Aizawa device. *Id.*

<u>Analysis</u>

Upon review of the foregoing, we conclude a preponderance of the evidence supports Petitioner's contention that a person of ordinary skill in

the art would have been motivated to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, in light of Inokawa.

First, a person of ordinary skill in the art would have been motivated to make this replacement to improve the pulse measurements recorded by Aizawa's detector 1. Inokawa teaches that the infrared LED's signal can be used "to detect vital signs" such as "body motion," and the green LED's signal can be "used to detect pulse." Ex. 1008, Fig. 2, ¶¶ 14, 58–59; Ex. 1003 ¶¶ 72–83, 109–119; Ex. 1047 ¶¶ 60–63.

Patent Owner correctly points out that Aizawa describes its single-emitter detector 1 as transmitting its pulse data to "a device for computing the amount of motion load from the pulse rate." Ex. 1006 ¶¶ 15, 28, 35. But, this description is the only disclosure in Aizawa cited by Patent Owner as relating to computing a motion characteristic of the user. Further, we are unable to discern any other disclosure in Aizawa relating to motion computation, or what Aizawa proposes to do with its motion computation. *See id.* Based on the sparse nature of Aizawa's disclosure concerning motion load, it is not clear exactly what Aizawa proposes to do with the computed motion load, after it is computed. *See, e.g.*, Ex. 1047 ¶ 60 ("Aizawa is silent on whether it uses the computed motion load to improve the detection signal."). Aizawa does, however, describe the motion load as being computed "from the pulse rate," rather than being an input to the pulse rate calculation. Ex. 1006 ¶¶ 15, 35.

Dr. Kenny, when asked whether it was his understanding that "Aizawa's sensor could not account for motion load?", answered that "Aizawa's sensor attempts to prevent motion load rather than account for it." Ex. 2007, 400:7–11. He explained that, because Aizawa uses only a single

emitter with a single wavelength, "what [Aizawa] sees as a signal would be some mixture of pulse rate and motion load if there was no effort to prevent motion load," so Aizawa seeks to solve the problem of "prevent[ing] motion load from corrupting the pulse rate signal." *Id.* at 400:12–401:10. Dr. Kenny did not further explain this distinction between preventing and accounting for motion load in his deposition testimony cited by the parties as relating to this issue. *Id.* at 400:7–402:4. We do not rely on this distinction as a basis for our present decision, because we find no express support for it in Aizawa's disclosure (*see* Ex. 1006 ¶¶ 15, 28, 35), and it is not explained in persuasive detail by Dr. Kenny.

We nonetheless credit Dr. Kenny's declaration testimony that a person of ordinary skill in the art, upon reviewing Inokawa's disclosure of using two emitters of different wavelengths to calculate a user's pulse and motion separately, would understand that these two separate measurements would enable the device to calculate a "more reliable" pulse rate because it "will allow noise arising from body motion to be better isolated and accounted for." Ex. 1047 ¶ 60; Ex. 1003 ¶¶ 110, 111. Aizawa does not disclose using the computed motion load in this fashion, so it appears that this would improve upon the accuracy of Aizawa's pulse measurements, by using the computed motion load to isolate and account for noise. *See* Ex. 1006 ¶¶ 15, 28, 35.

Dr. Madisetti also offers no meaningful opposing testimony in this regard. *See, e.g.*, Ex. 2004 ¶ 104. Instead, Dr. Madisetti incorrectly reads Dr. Kenny's motivation testimony as being limited to the desirability of adding the bare ability to measure body movement to Aizawa. *See id.* In fact, Dr. Kenny further testified that it would have been beneficial to *use* the

measured body movement to *improve* the pulse measurement of the device. *See* Ex. 1003 ¶¶ 69, 74; Ex. 1047 ¶ 60. Dr. Madisetti does not persuasively address the testimony supporting the Petition. *See* Ex. 2004 ¶ 104.

Thus, because Dr. Madisetti's testimony sets up a straw man to attack, rather than directly addressing the entirety of Dr. Kenny's testimony in this regard, Dr. Kenny's testimony stands unrebutted in the record before us. Dr. Kenny's testimony also makes intuitive sense that measuring the user's motion *separately* from the user's pulse, for example by using two interrogating emitters of two different wavelengths, would provide a reliable means of correcting the pulse data for motion artifacts by using the separately measured motion data, rather than by trying to segregate these two components in the single data stream provided by Aizawa's single emitter device. *See, e.g.*, Ex. 1047 ¶ 60. We, therefore, are persuaded by Dr. Kenny's unrebutted testimony that using two emitters of different wavelengths would improve Aizawa's device in this way.

Further, and independently, a person of ordinary skill in the art would have been motivated to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, to provide a reliable method of uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for display to the user. *See* Ex. 1003 ¶ 78. Inokawa expressly touts such optically-based uploading of data from Inokawa's wrist-worn sensor 1 to Inokawa's base device 17 as a benefit of incorporating two emitters in sensor 1. *See* Ex. 1008, Figs. 3, 19, ¶¶ 3–7, 14, 76–77, 109–111. Inokawa identifies two specific benefits of this optically-based data communication means. First, the infrared LED can transmit the pulse data, and the green LED can separately transmit "checksum" information to increase the

accuracy of data transmission. *Id.* at Fig. 19, ¶¶ 14, 109–111. Second, using light emitters in this fashion to perform two functions (data collection by emitting light into the user's wrist, and data transmission by emitting light to photodetectors in a base device) obviates the need for providing "a special wireless communication circuit [in the wrist-worn sensor 1] or a communication cable." *Id.* ¶¶ 3–7, 76–77; Ex. 1003 ¶ 78.

Patent Owner correctly points out that Aizawa already has a "transmitter" 4 for uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for processing and for display to the user. Ex. 1006, Fig. 1(b), ¶¶ 15, 23, 28, 35. However, Aizawa's Figure 1(b) illustrates transmitter 4 only as an empty box contained within outer casing 5, and Aizawa's written description does not provide further structural details concerning transmitter 4. *See id.* In particular, Aizawa does not describe exactly how transmitter 4 transmits its data to the other device. *See id.*

Patent Owner contends, and Dr. Madisetti and Dr. Kenny both testify, that Aizawa's transmitter 4 is a "wireless" transmitter. *See, e.g.*, PO Resp. 51; Ex. 2004 ¶¶ 105–106, 112; Ex. 2007, 403:17–22, 414:19–21. They all appear to equate "wireless" communication to radio frequency communication, and not to include optical communication, even though both radio frequency and optical communication do not use a wire. Petitioner disagrees that Aizawa discloses any specific form of data transmission, including wireless transmission. *See* Tr. 71:5–72:3 ("[T]he transmitter disclosure in Aizawa, they don't say its's a wireless transmitter. That was a conjuration by [Patent Owner]. They don't specify whether it's a wired or wireless."). We assume, for this decision, that Aizawa expressly

contemplates radio frequency communication as one embodiment by which transmitter 4 may transmit data to devices other than detector 1.

Patent Owner argues, and Dr. Madisetti testifies, that Aizawa's express disclosure goes even further. They assert Aizawa's "goal" is to measure and display pulse data *in real time during exercise*, using the wireless transmitter. *See, e.g.*, Ex. 2004 ¶¶ 106–108, 111. We find that Aizawa does not support this assertion. Instead, Aizawa discusses prior art devices that "estimat[e] a burden on the heart of a person who takes exercise by *real-time measuring* his/her heart rate at the time of exercise" (Ex. 1006 ¶ 4 (emphasis added)), and then describes Aizawa's detector 1 as having a transmitter for transmitting the measured pulse rate data to another device for display (*id.* ¶ 15). Aizawa does not indicate when this transmission occurs. Aizawa also refers to "noise caused by the shaking of the body of the subject" as a problem to be addressed (*id.* ¶ 6), but this problem occurs regardless of whether the shaking results from exercise or the normal movement of the user's wrist over the course of the day. Thus, Aizawa does not tout, as an important feature of Aizawa's invention, the *real time display* of pulse rate data during exercise, regardless of whether the data gathered by Aizawa's wrist-worn detector 1 is transmitted wirelessly or otherwise. *Id.* ¶¶ 4, 6, 15.

No doubt, a person of ordinary skill in the art would have viewed the capability of a wrist-worn pulse detector to transmit its pulse data to another device for display in real time while the user is exercising to be a desirable feature in some cases, even if this is not one of Aizawa's specifically stated goals. *See, e.g.*, Ex. 1003 ¶ 64 (Dr. Kenny stating: "By wirelessly transmitting the collected data wirelessly, Mendelson 2006's system

provides 'numerous advantages,' . . . ."); Ex. 2009, 393:6–14 (Dr. Kenny agreeing that a person of ordinary skill in the art "would have seen the ability to wirelessly transmit collected data as an advantage"). Nonetheless, Inokawa expressly discloses that, in other cases, the benefits achieved by wireless transmission can be outweighed by obviating the need for the wrist-worn sensor to include a special wireless communication circuit. *See* Ex. 1008 ¶¶ 3–7 (discussing problems associated with wireless transmission, such as the need for a dedicated circuit, which is avoided by Inokawa's system that risks "few malfunctions" and has a "simple structure"), 76–77 ("As a result, there is no need to use a special wireless communication circuit . . ., which makes it possible to transmit vital sign information to the base device 17 accurately, easily, and without malfunction."). We therefore conclude that Petitioner's case for obviousness in this regard is supported by a preponderance of the evidence. *See, e.g.*, *In re Urbanski*, 809 F.3d 1237, 1243–44 (Fed. Cir. 2016) (persons of ordinary skill in the art may be motivated to pursue desirable properties of one prior art reference, even at the expense of foregoing a benefit taught by another prior art reference).

We are not persuaded by Patent Owner's argument that Petitioner's case for obviousness is deficient on the basis that neither Aizawa nor Inokawa expressly discloses a wrist-worn sensor device that has *both* a plurality of emitters *and* at least four detectors, as claim 1 recites. Obviousness does not require "'some motivation or suggestion to combine the prior art teachings' [to] be found in the prior art." *KSR*, 550 U.S. at 407, 415–418. Nor does it require the bodily incorporation of Inokawa's device into Aizawa's device. *See, e.g.*, *In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (test for obviousness is not whether the features of one

reference may be bodily incorporated into the structure of the other reference, but rather is "what the combined teachings of the references would have suggested to those of ordinary skill in the art"); *see also In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) (nonobviousness is not established by attacking references individually when unpatentability is predicated upon a combination of prior art disclosures). Instead, "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton," and "in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle." *KSR*, 550 U.S. at 420–421.

In this case, a person of ordinary skill in the art would have been motivated to modify Aizawa's wrist-worn detector 1 to replace its single near infrared LED 21 with an infrared LED and a green LED, based on Inokawa, for all the reasons provided above. A person of ordinary skill in the art would additionally have known to keep all four detectors 22 that are already present in Aizawa's detector 1, so that "[e]ven when the attachment position of the sensor is dislocated, a pulse wave can be detected accurately," as disclosed by Aizawa. Ex. 1006 ¶¶ 9, 27. In short, the combination of Aizawa and Inokawa teaches that having multiple emitters is beneficial, and having multiple detectors is beneficial, for different and not inconsistent reasons.

Finally, we agree with Petitioner's position that any thermal interference and power consumption issues that may arise in Aizawa's wrist-worn pulse detector, by using two emitters instead of one emitter, are well within the capabilities of a POSITA to solve. We credit Dr. Kenny's testimony in this regard. *See* Ex. 1047 ¶ 63; Ex. 2007, 384:8–388:12. For

example, Dr. Kenny acknowledges that Aizawa already discloses adding additional emitters. Ex. 1003 ¶ 79 (citing Ex. 1006 ¶ 33). Dr. Kenny further testifies that this modification "amount[s] to nothing more than the use of a known technique [(i.e., Inokawa's use of two emitters in a wrist-worn pulse detector)] to improve similar devices [(i.e., Aizawa's wrist-worn pulse detector)] in the same way and combining prior art elements according to known methods to yield predictable results." *Id.* ¶¶ 77 ("Furthermore, one of ordinary skill would have readily understood how to select different photodiodes with different sensitivities to detect the different wavelengths of light emitted by the two LEDs."), 111.

Patent Owner cites several portions of Dr. Kenny's deposition testimony that, in Patent Owner's view, indicate Dr. Kenny fails to appreciate the significance of the thermal effects, optical interference complications, and power consumption needs, that are posed by adding a second emitter to Aizawa's device, and fails to explain how these issues would have been overcome. *See* PO Resp. 51–54 (citing Ex. 2007, 379:17–21, 384:8–388:16, 394:11–395:22, 405:2–7, 409:13–410:2; Ex. 2009, 381:18–382:8, 383:22–385:9, 390:5–392:3). We have reviewed this deposition testimony, and we conclude Patent Owner overstates its significance. It establishes, at most, that Dr. Kenny did not expressly address these issues in his declaration (Exhibit 1003), but Dr. Kenny's opinion is that these issues would have been within the capability of a person of ordinary skill in the art to resolve. Based on the evidentiary record presented to us, we agree with Dr. Kenny. For example, Inokawa discloses a wrist-worn pulse sensor 1 having two emitters 21 and 23 in close proximity to each other. *See* Ex. 1008, Figs. 1–2. An artisan must be presumed to

know something about the art apart from what the relied-upon references disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962).

Dr. Madisetti's testimony opposing Dr. Kenny's foregoing opinion is premised solely on Dr. Kenny's alleged failure to explain how the issues that arise from adding a second emitter to Aizawa would have been solved; Dr. Madisetti does not provide any affirmative reason why these issues would have been difficult for a person of ordinary skill in the art to solve, in the context of Aizawa's device or wrist-worn pulse sensing devices in general. *See* Ex. 2004 ¶¶ 109, 110.

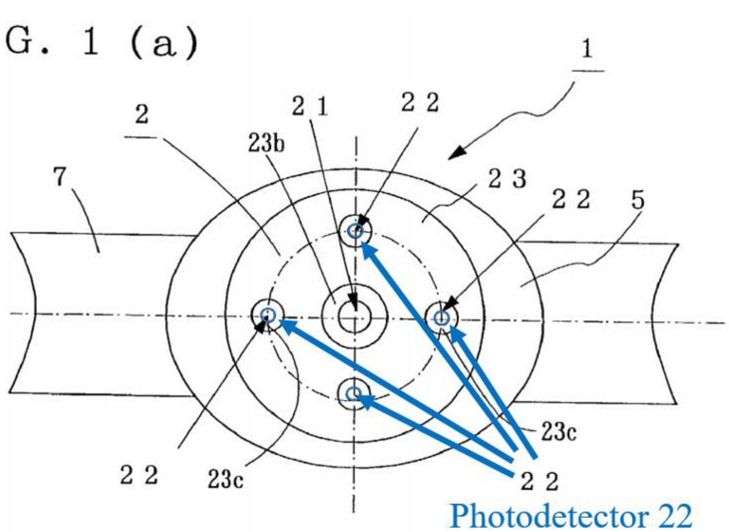
Thus, we conclude a person of ordinary skill in the art would have been motivated to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, and would have had a reasonable expectation of success in doing so.

iii. "[b] at least four detectors, wherein at least one of the at least four detectors is configured to detect light that has been attenuated by tissue of the user, and wherein the at least four detectors are arranged on a substrate;"

The cited evidence supports Petitioner's contention that Aizawa discloses at least four detectors, each stored in a separate cavity 23c, and configured to detect light output from a light emitting diode and reflected from the artery of a wrist. Pet. 19, 34–40; *see, e.g.*, Ex. 1006 ¶¶ 9, 23 ("four phototransistors 22"), 24 ("stored in cavities" and "set back from . . . detection face 23a"), Figs. 1(a)–1(b); Ex. 1003 ¶¶ 55–63, 68–94. Petitioner demonstrates how the claim requirement of detectors configured to detect light that has been attenuated by tissue is met by Aizawa's teaching of near infrared radiation output toward the wrist from the light emitting diode being reflected by a red corpuscle running through the artery of the wrist resulting

in reflected light being detected by the plurality of photodetectors so as to detect a pulse wave. Pet. 35 (quoting Ex. 1006 ¶ 27). As depicted below in annotated Figure 1(a) of Aizawa, "at least four photodetectors are 'disposed symmetrically' within holder 23 and used 'to detect the pulse wave of the wrist,' although the 'arrangement of the light emitting diode 21 and the photodetectors 22 is not limited to this.'" Pet. 36 (quoting Ex. 1006 ¶ 32).

FIG. 1 (a)



Annotated Figure 1(a) of Aizawa depicts four photodetectors 22, identified by blue arrows.

Relying on the testimony of Dr. Kenny, Petitioner contends that a person of ordinary skill in the art "would have found it obvious that Aizawa's photodetectors are arranged on a substrate because photodetectors 22 are disposed on a surface of holder 23 and are further connected, through the surface of holder 23, to drive detection circuit 24." Pet. 38 (citing Ex. 1003 ¶ 125). According to Dr. Kenny, the person of ordinary skill in the art would have understood that the surface of holder 23 acts as a substrate through which at least four photodetectors 22 and drive detection circuit 24 are connected and on which they are arranged because it

reduces the manufacturing complexity and footprint of the device as compared to using wires. Ex. 1003 ¶¶ 125–126.

To the extent Patent Owner's contentions related to the combinability of the references touch on this particular limitation, we address those arguments in full below.

iv. "[1c] a wall configured to circumscribe at least the at least four detectors"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses holder 23, which is a wall that surrounds detectors 22, as well as other elements. Pet. 40–43; *see, e.g.*, Ex. 1006 ¶ 23 ("holder 23 for storing . . . light emitting diode 21 and the photodetectors 22"), Figs. 1(a), 1(b); Ex. 1003 ¶¶ 130–139. Thus, Petitioner has demonstrated how the asserted prior art discloses a wall configured to circumscribe at least the at least four detectors.

v. "[d] a cover configured to be located between tissue of the user and the at least four detectors when the noninvasive optical physiological sensor is worn by the user, wherein the cover comprises a single protruding convex surface operable to conform tissue of the user to at least a portion of the single protruding convex surface when the noninvasive optical physiological sensor is worn by the user, and wherein the wall operably connects to the substrate and the cover."

<u>Petitioner's Undisputed Contentions</u>

Petitioner contends that Aizawa discloses a cover, i.e., an "acrylic transparent plate positioned between the photodetectors and the wrist," to improve adhesion between the sensor and the subject's wrist. Pet. 12 (citing Ex. 1006 ¶ 34). Patent Owner does not dispute this contention, and we agree with Petitioner. Aizawa discloses that "acrylic transparent plate 6 is provided on the detection face 23a of the holder 23 to improve adhesion to

the wrist 10." Ex. 1006 ¶ 34, Fig. 1(b) (depicting transparent plate 6 between sensor 2 and wrist 10).

Petitioner also contends that Ohsaki teaches a wrist-worn sensor that includes a "translucent board" having a convex surface that contacts the user's skin. Pet. 15, 24. Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki discloses that sensor 1 includes detecting element 2 and sensor body 3, and is "worn on the back side of the user's wrist." Ex. 1009 ¶ 16. Ohsaki discloses that detecting element 2 includes package 5 and "translucent board 8[,which] is a glass board which is transparent to light, and [is] attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8." *Id.* ¶ 17. As seen in Ohsaki's Figure 2, translucent board 8 has a single protruding convex surface, which is placed between a user's tissue and a light receiving element (e.g., photodetector) 7 when the sensor is worn. *Id.* at Fig. 2. As also seen in Figure 2, the board 8 is operably connected to the walls of sensor package 5. *Id.* ¶ 17 ("The translucent board 8 is . . . attached to the opening of the package 5."), Fig. 2.

Petitioner also contends that Ohsaki's Figure 2 depicts the user's tissue conforming to the shape of the convex surface of the cover. Pet. 13 ("The lens is sufficiently rigid to make the tissue conform to the convex surface of the lens."), 44–45. Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki's Figure 2 depicts the user's tissue 4 conforming to the shape of the protruding convex surface when the sensor is worn by the user. Ex. 1009 ¶ 17 ("The translucent board 8 is a glass board."), Fig. 2.

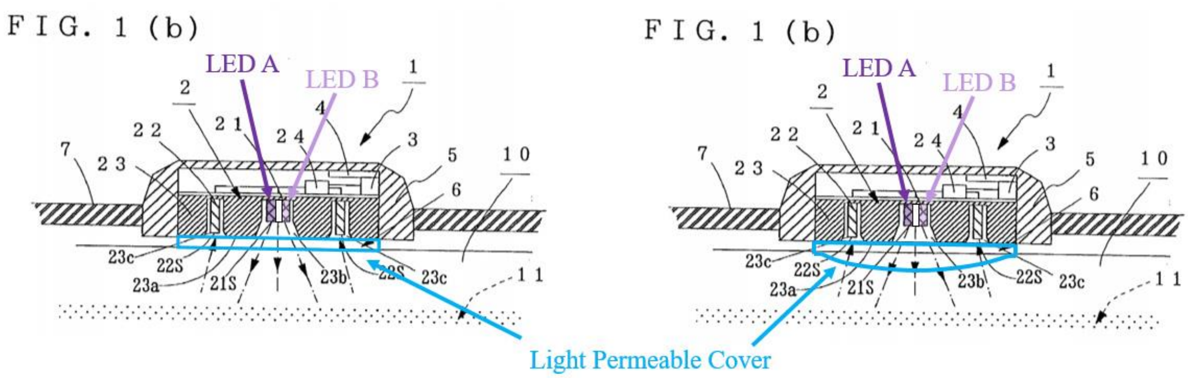
Petitioner's Disputed Contentions

Petitioner further contends that a person of ordinary skill in the art "would have found it obvious to modify the sensor's flat cover [in Aizawa] . . . to include a lens/protrusion . . . similar to Ohsaki's translucent board 8, so as to [1] improve adhesion between the user's wrist and the sensor's surface, [2] improve detection efficiency, and [3] protect the elements within sensor housing." Pet. 27–28 (citing, e.g., Ex. 1003 ¶¶ 86–88; Ex. 1009 ¶ 25). Petitioner contends that Ohsaki's convex surface is in "intimate contact" with the user's tissue, which prevents slippage of the sensor and increases signal strength because "variation of the amount of the reflected light . . . that reaches the light receiving element 7 is suppressed" and because "disturbance light from the outside" is prevented from penetrating board 8, as compared to a sensor with a flat surface. *Id.* at 25–26 (citing, e.g., Ex. 1003 ¶ 85; quoting Ex. 1009 ¶¶ 15, 17, 25, Figs. 1, 2, 4A, 4B). Accordingly, Petitioner contends that a person of ordinary skill in the art would have modified Aizawa's sensor to include a cover with a single convex protrusion, as taught by Ohsaki, that "is located between the user tissue and the detectors 22 when the sensor is worn by the user." Pet. 44–45 (citing, e.g., Ex. 1003 ¶¶ 55–63, 144).

Petitioner contends this modification would have been "nothing more than the use of a known technique to improve similar devices in the same way," i.e., "simply improving Aizawa-Inokawa's transparent plate 6 that has a flat surface to improve adhesion to a subject's skin and reduce variation in the signals detected by the sensor." Pet. 28 (citing Ex. 1003 ¶¶ 84–91). Further according to Petitioner, "the elements of the combined system would each perform similar functions they had been known to perform prior to the

combination—Aizawa-Inokawa's transparent plate 6 would remain in the same position, performing the same function, but with a convex surface as taught by Ohsaki." *Id.* (citing Ex. 1003 ¶¶ 84–91).

To illustrate its proposed modification, Petitioner includes two annotated versions of Aizawa's Figure 1(b), both of which are reproduced below. Pet. 27–28 (citing Ex. 1003 ¶¶ 84–91).



Petitioner's annotated figure on the left depicts Aizawa's sensor, modified to include LED B and with a flat "light permeable cover" (illustrated with blue outline); Petitioner's annotated figure on the right depicts Aizawa's sensor, again modified to include LED B and with a convex "light permeable cover" (illustrated with blue outline).

<u>Patent Owner's Arguments</u>

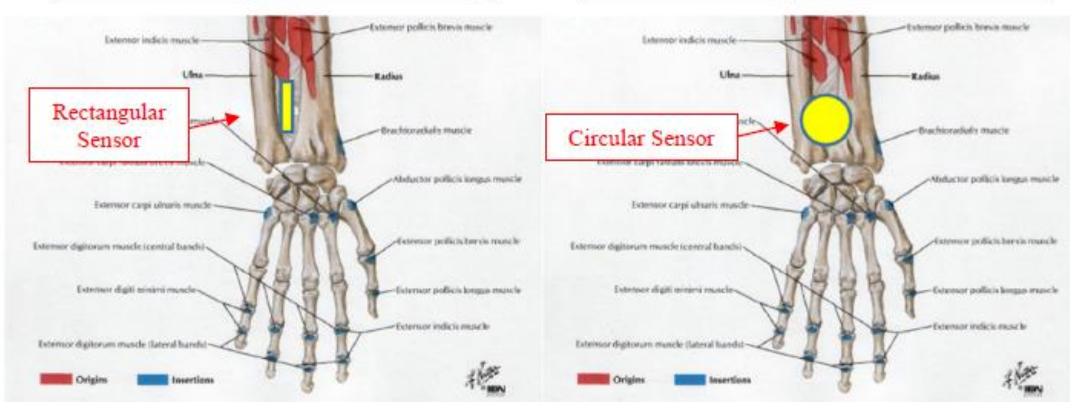
Patent Owner argues that a person of ordinary skill in the art would not have been motivated to modify Aizawa's sensor to include Ohsaki's convex cover. PO Resp. 17–48; Sur-reply 3–23.

First, Patent Owner argues "Ohsaki's rectangular board would be incompatible with Aizawa's circular sensor arrangement" and that the proposed modification "changes Ohsaki's structure and eliminates the longitudinal shape that gives Ohsaki's translucent board the ability to

prevent slipping." PO Resp. 18–19 (emphases omitted). This argument is premised on Patent Owner's contention that Ohsaki's convex cover must be rectangular, with the cover's long direction aligned with the length of the user's forearm, to avoid interacting with bones in the wrist and forearm. *Id.* at 20–23 (citing, e.g., Ex. 2004 ¶¶ 52–55; Ex. 1009 ¶¶ 6, 19, 23, 24); *see also* Sur-reply 3–10. According to Patent Owner, Ohsaki teaches that "aligning the sensor's longitudinal direction with the circumferential direction of the user's wrist undesirably results in 'a tendency [for Ohsaki's sensor] to slip off.'" PO Resp. 21 (emphasis omitted) (alteration in original) (citing Ex. 1009 ¶ 19).

Thus, Patent Owner contends that Petitioner's proposed modification would "chang[e] Ohsaki's rectangular board into a circular shape," which "would eliminate the advantages discussed above" because it "cannot be placed in any longitudinal direction and thus could not coincide with the longitudinal direction of the user's wrist." *Id.* at 21–22 (emphases omitted) (citing Ex. 2004 ¶¶ 55–57). Patent Owner presents annotated Figures depicting what it contends is Ohsaki's disclosed sensor placement as compared to that of the proposed modification, reproduced below.

Ohsaki's Longitudinal Teachings Petitioner's Proposed Combination



Patent Owner's annotated Figure on the left depicts a rectangular sensor placed between a user's radius and ulna, while Patent Owner's annotated Figure on the right depicts a circular sensor placed across a user's radius and ulna. Based on these annotations, Patent Owner argues that the proposed "circular shape would press on the user's arm in all directions and thus would not avoid the undesirable interaction with the user's bone structure," such that a skilled artisan "would have understood that any such change would eliminate Ohsaki's benefit of preventing slipping." PO Resp. 23–25 (citing, e.g., Ex. 2004 ¶¶ 56–57, 59–61).

Second, Patent Owner argues that Ohsaki requires its sensor be placed on the back of the user's wrist to achieve any benefits, but that such a location would have been unsuitable for Aizawa's sensor. PO Resp. 27–28. Specifically, Patent Owner argues that Aizawa's sensor must be worn on the palm side of the wrist, close to radial and ulnar arteries, which is the side opposite from where Ohsaki's sensor is worn. *Id.* at 28–29 (citing, e.g., Ex. 1006 ¶¶ 2, 7, 9, 26, 27, 36; Ex. 2004 ¶¶ 66–70). According to Patent Owner, Ohsaki teaches that the sensor's convex surface has a tendency to slip when placed on the palm side of the wrist, i.e., in the location taught by Aizawa. *Id.* at 33–36 (citing, e.g., Ex. 1009 ¶¶ 19, 23, 24; Ex. 2004 ¶¶ 74–80). Thus, Patent Owner argues that a person of ordinary skill in the art "would not have been motivated to use Ohsaki's longitudinal board—designed to be worn on the back side of a user's wrist—with Aizawa's palm-side sensor." *Id.* at 36 (emphases omitted). Similarly, Patent Owner argues that Aizawa teaches away from the proposed modification because Aizawa teaches that its flat acrylic plate improves adhesion on the palm side of the

wrist, while Ohsaki teaches that its convex board "has a tendency to slip" on the palm side of the wrist. *Id.* at 37–39 (citing, e.g., Ex. 2004 ¶¶ 82–84).

Third, Patent Owner argues that a person of ordinary skill in the art would not have placed Ohsaki's convex cover over Aizawa's peripheral detectors because the convex cover would condense light toward the center and away from Aizawa's detectors, which would decrease optical signal strength. PO Resp. 39–46 (citing, e.g., Ex. 2004 ¶¶ 85–97). Patent Owner also contends that Petitioner and Dr. Kenny admitted as much in a related proceeding. *Id.* at 40–41 (citing, e.g., Ex. 2019, 45; Ex. 2020, 69–70). Patent Owner also relies on Figure 14B of the '553 patent to support its position. *Id.* at 44–45 (citing Ex. 1001, 36:3–6, 36:13–15). Additionally, Patent Owner argues that its position is also supported by Inokawa, which also uses a convex lens to direct light toward the center but, in Inokawa's structure, the light is directed from peripheral emitters toward a central detector. *Id.* at 45–46 (citing, e.g., Ex. 1008 ¶¶ 15, 58). In light of the foregoing, Patent Owner argues that a person of ordinary skill in the art would have understood that the proposed modification would have decreased signal strength by directing light away from Aizawa's peripheral detectors. *Id.*

Fourth and finally, Patent Owner argues that a person of ordinary skill in the art "would have understood that Aizawa's flat plate would provide better protection than a convex surface" because it "would be less prone to scratches." *Id.* at 47–48 (citing Ex. 1008 ¶ 106; Ex. 2004 ¶ 98).

<u>Petitioner's Reply</u>

Concerning Patent Owner's first and second arguments, Petitioner responds that Ohsaki does not disclose the shape of its protrusion, other than

its convexity as shown in Figures 1 and 2, nor does Ohsaki require a rectangular shape or placement on the back of the wrist in order to achieve the disclosed benefits. Pet. Reply 8–9, 13–20 (citing, e.g., Ex. 1047 ¶¶ 16–28). Moreover, Petitioner asserts that "even if Ohsaki's translucent board 8 were somehow understood to be rectangular, obviousness does not require 'bodily incorporation' of features from one reference into another"; rather, a person of ordinary skill in the art "would have been fully capable of modifying Aizawa to feature a light permeable protruding convex cover to obtain the benefits" taught by Ohsaki. *Id.* at 15–16 (citing, e.g., Ex. 1047 ¶ 21). Similarly, regarding the location of the sensor, Petitioner asserts,

> [E]ven assuming for the sake of argument that a POSITA would have understood Aizawa's sensor as being limited to placement on the palm side of the wrist, and would have understood Ohsaki's sensor's "tendency to slip" when arranged on the front side as informing consideration of Ohsaki's teachings with respect to Aizawa, that would have further motivated the [person of ordinary skill in the art] to implement a light permeable convex cover in Aizawa's sensor, to improve detection efficiency of that sensor when placed on the palm side.

Id. at 17–18 (citing, e.g., Ex. 1047 ¶ 25). In other words, Ohsaki's disclosure that a convex surface suppresses variation in reflected light would have motivated an artisan to add such a surface to Aizawa to improve detection efficiency of that sensor when placed on the palm side. *Id.* at 18.

Concerning Patent Owner's third argument, Petitioner responds that adding a convex cover to Aizawa's sensor would not decrease signal strength but, instead, "would improve Aizawa's signal-to-noise ratio by causing more light backscattered from tissue to strike Aizawa's photodetectors than would have with a flat cover" because such a cover

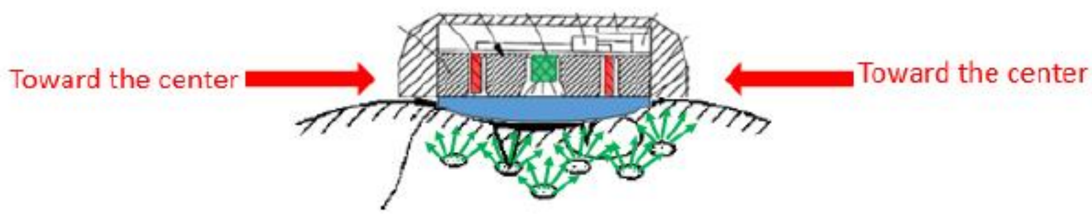
improves light concentration across the entire lens and does not direct it only towards the center. *Id.* at 20–28 (citing, e.g., Ex. 1047 ¶¶ 29–57).

Petitioner asserts that Patent Owner and Dr. Madisetti "ignore[] the well-known principle of reversibility," by which "a ray going from P to S will trace the same route as one from S to P." Pet. Reply 20–22 (quoting Ex. 1040, 92; citing, e.g., Ex. 1040, 87–92; Ex. 1049, 106–111; Ex. 1047 ¶ 33). When applied to Aizawa's sensor, Petitioner contends that any condensing benefit achieved by a convex cover would thus direct emitted light toward Aizawa's peripheral detectors. *Id.* at 21–22 (citing, e.g., Ex. 1047 ¶¶ 32–38). Although Dr. Madisetti "refused to acknowledge this basic principle of reversibility during deposition," Petitioner contends this core concept of reversibility is applied in Aizawa. *Id.* at 22 (citing, e.g., Ex. 1041, 89:12–19; Ex. 1003 ¶¶ 83, 79; Ex. 1047 ¶ 32, 36–37).

Petitioner also asserts that Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue will be scattered and diffuse and will approach the detectors "from various random directions and angles." Pet. Reply 23–25 (citing, e.g., Ex. 1019, 52, 86, 90; Ex. 1042, 803; Ex. 1047 ¶¶ 39–40; Ex. 2006, 163:12–164:2). This scattered and diffuse light, according to Petitioner, means that Ohsaki's convex cover cannot "focus all light at the center of the sensor device," as Patent Owner argues. *Id.* at 24. Instead, due to the random nature of this scattered light, Petitioner asserts that a person of ordinary skill in the art would have understood that "Ohsaki's convex cover provides at best a slight refracting effect, such that light rays that otherwise would have missed the detection area are instead directed toward that area as they pass through the interface provided by the cover." *Id.* at 25 (citing, e.g., Ex. 1047 ¶¶ 46–48). Petitioner applies this

understanding to Aizawa, and asserts that using a cover with a convex protrusion in Aizawa would "enable backscattered light to be detected within a circular active detection area surrounding" a central light source, thereby "allow[ing] a larger fraction of light randomly backscattered from tissue to be detected within the active detection area surrounding [the light] source." *Id.* at 25–27 (citing, e.g., Ex. 1019, 86, 90; Ex. 1047 ¶¶ 41–48).

Petitioner relies upon the following illustration of this alleged effect. Pet. Reply 28 (citing Ex. 1047 ¶ 55).



The above illustration depicts backscattered light with Aizawa's sensor reflecting off user tissue in various directions, such that it impinges upon the peripheral detectors from various random angles and directions. *Id.* According to Petitioner, this "allow[s] the detector to capture light that otherwise would have been missed by the detectors, regardless of their location within the sensor device." *Id.*

Petitioner also dismisses Patent Owner's reliance on Figure 14B of the '553 patent because it "is not an accurate representation of light that has been reflected from a tissue measurement site. For example, the light rays (1420) shown in FIG. 14B are collimated (i.e., travelling paths parallel to one another), and each light ray's path is perpendicular to the detecting surface." Pet. Reply 26 (citing, e.g., Ex. 1047 ¶¶ 49–51).

Concerning Patent Owner's fourth argument, Petitioner responds that even if a flat surface might be less prone to scratching, that possible

disadvantage would have been weighed against the "known advantages of applying Ohsaki's teachings," and would not negate a motivation to combine. *Id.* at 28–29 (citing, e.g., Ex. 1047 ¶ 58).

<u>Patent Owner's Sur-reply</u>

Concerning Patent Owner's first and second arguments, Patent Owner reiterates its position that Ohsaki's purported benefits attach only to a sensor with a rectangular convex surface that is located on the back of the wrist, and that "even small changes in sensor orientation or measurement location result in slippage." Sur-reply 3–14, 8.

Concerning Patent Owner's third argument (that the convex cover would condense light toward the center and away from Aizawa's detectors), Patent Owner asserts that Petitioner's Reply improperly presents several new arguments, relying on new evidence, as compared with the Petition. *Id.* at 16 (regarding reversibility), 16–20. Patent Owner argues that Dr. Kenny and Petitioner have not overcome their admissions that a convex lens directs light toward the center. *Id.* at 14–16, 19. Moreover, Patent Owner argues that Petitioner's discussion of the principle of reversibility is "irrelevant" because it "assumes conditions that are not present when tissue scatters and absorbs light." *Id.* at 16–17. The random nature of backscattered light, in Patent Owner's view, "hardly supports Petitioner's argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed," and is irrelevant to the central issue presented here of "whether changing Aizawa's flat surface to a convex surface results in more light on Aizawa's peripherally located detectors." *Id.* at 18.

Patent Owner also asserts that Petitioner mischaracterizes Patent Owner's position, which is not that Ohsaki's cover with a convex protrusion

"focuses ***all*** light to a single point" at the center of the sensor as Petitioner characterizes it. Sur-reply 19. Patent Owner's position, rather, is that Petitioner has not shown that a person of ordinary skill in the art "would have been motivated to change Aizawa's flat surface to a convex surface to improve signal strength." *Id.* at 19. In Patent Owner's view, by arguing that the convex cover provides only a "slight refracting effect," Petitioner undermines its contention that providing such a cover would have improved detection efficiency. *Id.*

Patent Owner also argues that Petitioner's contention that a convex cover allows more light collection generally is a new theory not supported by Dr. Kenny's original declaration. *Id.* at 20. Moreover, Patent Owner argues that Petitioner's theory is "unavailing because it fails to consider the greater decrease in light at the detectors due to light redirection to a more central location." *Id.* at 21. According to Patent Owner, any light redirected from the sensor's edge could not make up for the loss of signal strength from light redirected away from the detectors and toward the center. *Id.*

Concerning Patent Owner's fourth argument, Patent Owner argues that Petitioner does not dispute Patent Owner's position that a flat cover would be less prone to scratches and offers "***no*** plausible advantages for its asserted combination." *Id.* at 23. Moreover, Patent Owner argues that the risk of scratches undermines Petitioner's argument of adding a convex cover to protect the elements within the sensor housing. *Id.*

<u>Analysis</u>

As noted above, Petitioner provides three rationales to support its contention that a person of ordinary skill in the art would have provided "a light permeable cover with a protruding convex surface," such as that taught

by Ohsaki, to Aizawa's sensor: (1) to improve adhesion between the sensor and the user's tissue, (2) to improve detection efficiency, and (3) to protect the elements within the sensor housing. Pet. 36–37 (citing, e.g., Ex. 1003 ¶¶ 94–97; Ex. 1009 ¶ 25). As further examined below, we determine all three rationales are supported by the evidence, and further that any single rationale standing alone would have been sufficient to establish a basis for the person of ordinary skill in the art to combine the references as proposed.

Rationales 1 and 2

The evidence of record persuades us that adding a convex cover, such as that taught by Ohsaki, would have improved adhesion between the sensor and the user's skin, which would have increased the signal strength of the sensor. Ohsaki teaches as much:

> [T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby *it is prevented that the detecting element 2 slips off* the detecting position of the user's wrist 4. If the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4 as shown in Fig. 4B. However, in the case that the translucent board 8 has a convex surface like the present embodiment, the *variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.* Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25 (emphasis added); *see also id.* ¶ 27 ("detecting element 2 is stably fixed").

We credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated by such teachings to apply a cover with a

convex surface to Aizawa to improve that similar device in the same way and to yield predictable results, i.e., to resist movement of the sensor on the user's wrist and to suppress variation. *See, e.g.*, Ex. 1003 ¶¶ 85 ("[T]his contact between the convex surface and the user's skin is said to prevent slippage, which increases the strength of the signals obtainable by Ohsaki's sensor."), 87, 152 ("[O]ne of ordinary skill would have understood that this adjustment would improve adhesion to the user's skin and reduce variation in the signals detected by the sensor."). We find persuasive Dr. Kenny's explanation that the person of ordinary skill in the art "would have understood that a protruding convex cover would reduce the adverse effects of user movement on signals obtainable by the photodetectors within Aizawa's sensor, which like Ohsaki's light receiving elements, detect light reflected from user tissue." Ex. 1047 ¶ 12.

Indeed, Ohsaki expressly compares the performance of a wrist-worn pulse wave sensor depending on whether translucent board 8 is convex or flat, and concludes the convex surface results in improved performance over the flat surface, especially when the user is moving. Ex. 1009, Figs. 4A–4B, ¶¶ 15, 25 (stating that with "a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4," and with "a convex surface like the present embodiment, the variation of the amount of the reflected light" collected by the sensor "is suppressed"). Ohsaki also states that, with a convex surface, "[i]t is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8." *Id.* ¶ 25.

We also credit Dr. Kenny's testimony that the proposed modification would have been within the skill level of an ordinary artisan. For example, Dr. Kenny testifies:

> One of ordinary skill would have combined the teachings of Aizawa-Inokawa and Ohsaki as doing so would have amounted to nothing more than the use of a known technique to improve similar devices in the same way. One of ordinary skill would have recognized that incorporating Ohsaki's convex surface is simply improving Aizawa-Inokawa's transparent plate 6 that has a flat surface to improve adhesion to a subject's skin and reduce variation in the signals detected by the sensor. [Ex. 1009 ¶ 25]. Furthermore, the elements of the combined system would each perform similar functions they had been known to perform prior to the combination—Aizawa-Inokawa's transparent plate 6 would remain in the same position, performing the same function, but with a convex surface as taught by Ohsaki.

Ex. 1003 ¶ 91; *see also id.* ¶¶ 77–91. In light of Ohsaki's express disclosure of the benefits of a convex cover, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to modify Aizawa as proposed, and would have had a reasonable expectation of success in doing so.

We next address Patent Owner's first through third arguments, each of which implicates Petitioner's first and second asserted rationales of improved adhesion and detection efficiency.

Patent Owner's first argument is premised on the notion that Ohsaki's benefits only can be realized with a rectangular convex surface, because such a shape is required to avoid interacting with bones on the back of the user's forearm. PO Resp. 19–27. We disagree. Ohsaki does not disclose the shape of its convex cover, much less require it be rectangular. In fact,

Ohsaki is silent as to the shape of the convex surface. Ohsaki discloses that sensor 1 includes detecting element 2, which includes package 5 within which the sensor components are located. Ex. 1009 ¶ 17. Ohsaki's convex surface is located on board 8, which is "attached to the opening of the package 5." *Id.* Ohsaki provides no further discussion regarding the shape of board 8 or its convex protrusion.

We disagree with Patent Owner's suggestion that the shape of the convex surface can be inferred to be rectangular from Ohsaki's Figures 1 and 2. PO Resp. 14–16. Ohsaki does not indicate that these figures are drawn to scale, or reflect precise dimensions or shapes of the convex surface. *See, e.g.*, Ex. 1009 ¶ 13 ("schematic diagram"); *see also* Pet. Reply 13–15; *Hockerson-Halberstadt, Inc. v. Avia Group Int'l*, 222 F.3d 951, 956 (Fed. Cir. 2000) ("[I]t is well established that patent drawings do not define the precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue.").

To be clear, Ohsaki describes the shape of *detecting element 2* as rectangular: "[T]he length of the detecting element from the right side to the left side in FIG. 2 is longer than the length from the upper side to the lower side." Ex. 1009 ¶ 19. Ohsaki also describes that detecting element 2 is aligned longitudinally with the user's forearm: "[I]t is desirable that the detecting element 2 is arranged so that its longitudinal direction agrees with the longitudinal direction of the user's arm," to avoid slipping off. *Id.*; *see also id.* ¶ 9 ("The light emitting element and the light receiving element are arranged in the longitudinal direction of the user's arm.").

In light of this disclosed rectangular shape of detecting element 2, it is certainly possible that Ohsaki's convex surface may be similarly shaped. But, it may not be. Contrary to Patent Owner's argument, Ohsaki neither describes nor requires detecting element 2 to have the same shape as the convex surface of board 8. *Accord* Pet. Reply. 13–16 (noting also that Ohsaki's board 8 "is not coextensive with the entire tissue-facing side of detecting element 2"). We have considered the testimony of both Dr. Kenny and Dr. Madisetti on this point. Ex. 1047 ¶¶ 10–11, 14, 16–21; Ex. 2004 ¶¶ 39–42 (relying on Ohsaki's Figures 1–2 to support his opinion that the convex surface is rectangular). Dr. Madisetti's reliance on the dimensions of Ohsaki's figures is unpersuasive. *Hockerson-Halberstadt*, 222 F.3d at 956. We credit Dr. Kenny's testimony that Ohsaki does not describe its convex surface as rectangular, because this testimony is most consistent with Ohsaki's disclosure.

Further, Patent Owner suggests that the convex surface *must be* rectangular, in order to avoid interacting with bones in the user's forearm. PO Resp. 21–23; Sur-reply 9 ("[A] POSITA would have understood Ohsaki's convex board must also have a longitudinal shape oriented up-and-down the watch-side of the user's wrist/forearm."). Although Ohsaki recognizes that interaction with these bones can cause problems, *see* Ex. 1009 ¶¶ 6, 19, we do not agree that the *only way* to avoid these bones is by aligning a rectangular cover with the longitudinal direction of the user's forearm. For example, in the annotated Figures provided by Patent Owner, *see* PO Resp. 22, we discern that the circular sensor that purports to depict the proposed modification would *also* avoid the bones in the forearm if it were slightly smaller. Patent Owner provides no persuasive explanation to

justify the dimensions it provides in this annotated figure, or to demonstrate that such a large sensor would have been required. Indeed, we discern that it would have been within the level of skill of an ordinary artisan to appropriately size a modified sensor to avoid these well-known anatomical obstacles. "A person of ordinary skill is also a person of ordinary creativity, not an automaton." *KSR*, 550 U.S. at 421. After all, an artisan must be presumed to know something about the art apart from what the references disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962).

Finally, we do not agree with Patent Owner's position that Ohsaki's advantages apply only to rectangular convex surfaces. As discussed, Patent Owner has not shown that Ohsaki's convex surface is rectangular at all. Moreover, even if Ohsaki's convex surface is rectangular, when discussing the benefits associated with a convex cover, Ohsaki does not limit those benefits to a cover of any particular shape. Instead, Ohsaki explains that "detecting element 2 is arranged on the user's wrist 4 so that the convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby it is prevented that the detecting element 2 slips off the detecting position of the user's wrist 4." Ex. 1009 ¶ 25; Ex. 1047 ¶ 10. Thus, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa's circular-shaped sensor, to improve adhesion as taught by Ohsaki. *See, e.g.*, Pet. 24–25. Nothing in Ohsaki's disclosure limits such a benefit to a specific shape of the convex surface. Ex. 1047 ¶¶ 10–11, 14–21.

Moreover, Ohsaki contrasts the ability to properly receive reflected light with a convex surface as compared to a flat surface and notes that,

> in the case that the translucent board 8 has a convex surface . . . the variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25; Ex. 1047 ¶ 11. Again, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa's sensor, to improve signal strength, as taught by Ohsaki. *See, e.g.*, Pet. 24–27. Again, nothing in Ohsaki's disclosure limits such a benefit to the shape of the convex surface. Ex. 1047 ¶¶ 10–12, 13, 16–21.

Accordingly, we do not agree that Ohsaki's disclosed advantages attach only to a rectangular convex surface, or would have been inapplicable to the proposed combination of Aizawa and Ohsaki.

We have considered Patent Owner's second argument, that Ohsaki's benefits are realized only when the sensor and convex surface are placed on the back of the user's wrist, which is the opposite side of the wrist taught by Aizawa. PO Resp. 27–36. We do not agree. As an initial matter, Petitioner does not propose bodily incorporating the references; Petitioner simply proposes adding a convex cover to Aizawa's sensor, without discussing where Aizawa's sensor is used. *See, e.g.*, Pet. 28. In other words, Petitioner's proposed modification does not dictate any particular placement, whether on the palm side or back side of the wrist.

To be sure, Ohsaki's Figures 3A–3B compare the performance of detecting element 2, including its translucent board 8 having a convex

protrusion, and show better performance when the element is attached to the back side of the wrist versus the front side of the wrist, when the user is in motion. *See* Ex. 1009 ¶¶ 23–24, Figs. 3A–3B. However, we do not agree that these figures support Dr. Madisetti's conclusion that "Ohsaki indicates a convex surface only prevents slipping on the back (i.e., watch) side of the wrist in a specific orientation, but tends to slip when used in different locations or orientations" such as the palm side of the wrist—particularly in comparison to a flat surface such as Aizawa's. Ex. 2004 ¶¶ 66, 75. Instead, Ohsaki acknowledges that, even when the detecting element is located "on the front [palm] side of the user's wrist 4, *the pulse wave can be detected well* if the user is at rest." Ex. 1009 ¶ 23 (emphasis added). Thus, Ohsaki discloses that, in at least some circumstances, a convex surface located on the front of the user's wrist achieves benefits. *Id.* Notably, Ohsaki's claims are not limited to detection during movement or exercise.

We credit, instead, Dr. Kenny's testimony that a person of ordinary skill in the art would have understood from Ohsaki that a convex protrusion will help prevent slippage, even in the context of Aizawa's sensor. *See* Ex. 1047 ¶¶ 10, 15, 22–28, 73. This is because the convex protrusion "promot[es] 'intimate contact with the surface of the user's skin,'" which "would have increased adhesion and reduced slippage of Aizawa's sensor when placed on the palm side of a user's wrist, with associated improvements in signal quality." *Id.* ¶¶ 27, 28 ("additional adhesive effect").

Dr. Madisetti testifies that

> [b]ased on Aizawa's teaching that a flat acrylic plate improves adhesion on the palm side of the wrist, and Ohsaki's teaching that a convex surface tends to slip on the palm side of the wrist, a

> [person of ordinary skill in the art] would have come to the opposite conclusion from Dr. Kenny: that modifying Aizawa's flat adhesive plate "to include a lens/protrusion . . . similar to Ohsaki's translucent board' would not 'improve adhesion."

Ex. 2004 ¶ 84; *see also id.* ¶ 82. We disagree with this reading of Aizawa. It is true that Aizawa's plate 6 is illustrated as having a flat surface (Ex. 1006, Fig. 1(b)), and that Aizawa states the plate "improve[s] adhesion" (*id.* ¶ 13). Aizawa further states: "the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10," and "[t]hereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶ 26. These disclosures, however, indicate the improved adhesion is provided by the acrylic material of plate 6, not the shape of the surface of the plate, which is never specifically addressed. *See also id.* ¶¶ 30, 34 ("Since the acrylic transparent plate 6 is provided . . . adhesion between the pulse rate detector 1 and the wrist 10 can be improved . . . ."). Aizawa does not associate this benefit of improved adhesion with the surface shape of the plate, but rather, with the existence of an acrylic plate to begin with. Thus, there is no teaching away from using a convex surface to improve the adhesion of Aizawa's detector to the user's wrist.

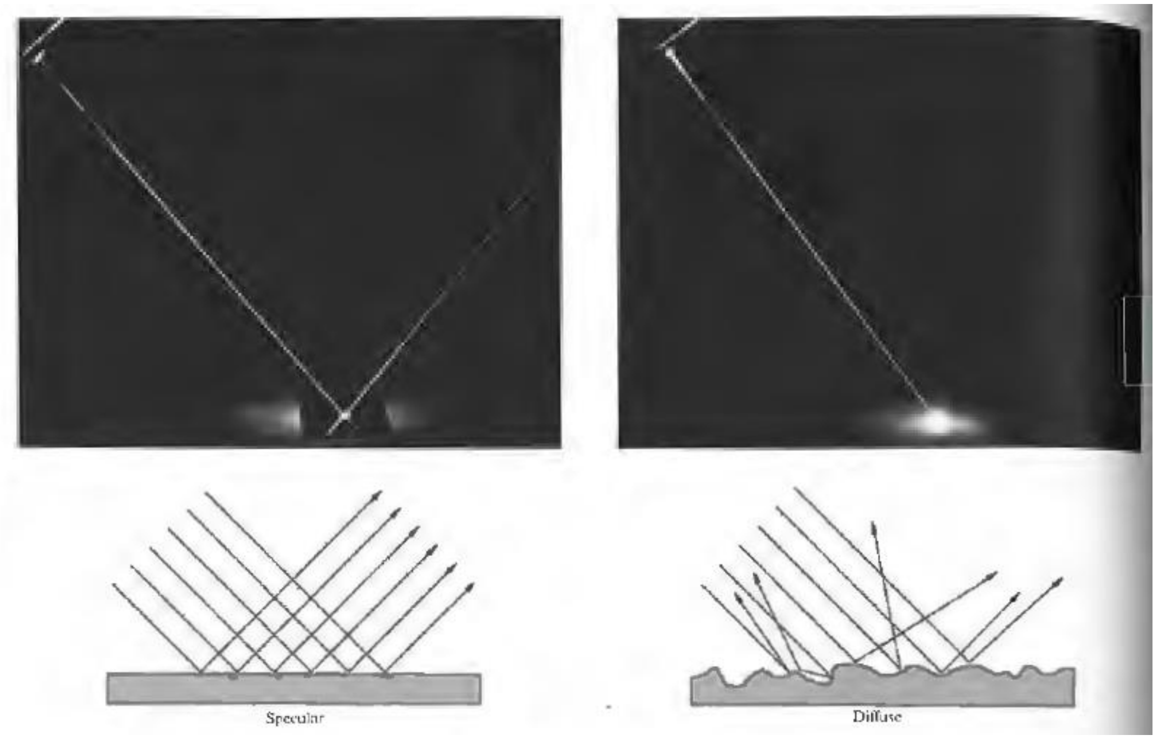
We have considered Patent Owner's third argument that a convex cover would condense light away from Aizawa's peripheral detectors, which Patent Owner alleges would decrease signal strength. PO Resp. 39–46. We disagree.

There appears to be no dispute that when emitted light passes through user tissue, the light diffuses and scatters as it travels. *See, e.g.*, Pet. Reply 22–26; Tr. 27:18–28:4 (Petitioner's counsel agreeing that "the incoming light from a detection standpoint is going to be coming from all

sorts of different directions because of the randomness caused by the back scattering"), 65:23–66:16 (Patent Owner's counsel agreeing that light does not simply enter tissue and come back out "like it came out on a mirror"); Ex. 1041, 35:19–37:18 (Patent Owner's declarant describing light scattering as it travels through tissue, e.g., reflecting off blood, tissue, or other material); Ex. 1043, 28:2–10 (Patent Owner's declarant agreeing that reflecting light can be a signal for the '553 patent's sensor), 61:20–62:4 (explaining that "a light in this context, light emitted from the LEDs is diffused through the skin in that particular context, whatever that is"); Ex. 1047 ¶ 36.

The light thus travels at random angles and directions, and no longer travels in a collimated and perpendicular manner. Exhibit 1040,[5] Figure 4.12, illustrates the difference between diffuse and collimated light, and is reproduced below:

[5] Eugene Hecht, *Optics* (2nd ed. 1990).



This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a photograph and an illustration of incoming collimated light reflecting from a rough surface. *See* Ex. 1040, 87–88 (original page numbers). The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. *See id.* The rough surface provides diffuse reflection, in which the reflected light rays travel in random directions. *See id.*; *see also* Ex. 1047 ¶ 51 ("A [person of ordinary skill in the art] would have understood . . . the light that backscatters from the measurement site after diffusing through tissue reaches the circular active detection area provided by Aizawa's detectors from various random directions and angles.").

Dr. Kenny testifies that Aizawa "detect[s] light that has been 'partially reflected, transmitted, absorbed, and scattered by the skin and other tissues

and the blood before it reaches the detector.'" Ex. 1047 ¶ 51 (quoting Ex. 1019, 86). Dr. Kenny further opines that a convex cover, when added to Aizawa's sensor with multiple detectors symmetrically arranged about a central light source, allows light rays that otherwise would have missed the detection area to instead be directed toward that area as they pass through the interface provided by the cover, thus increasing the light-gathering ability of Aizawa's sensor. *Id.* ¶¶ 46–48.

By contrast Dr. Madisetti testifies that "a convex surface condenses light passing through it towards the center of the sensor and away from the periphery." Ex. 2004 ¶ 86; *see also id.* ¶¶ 85, 89. We have considered this testimony, however, Dr. Madisetti's opinions largely are premised upon the behavior of collimated and perpendicular light as depicted in Figure 14B of the challenged patent. *See id.* ¶ 88. Dr. Madisetti does not explain how light would behave when approaching the sensor from various angles, as it would after being reflected by tissue. *Id.* ¶¶ 86–89; *see also id.* ¶¶ 90–97 (addressing motivation and also failing to discuss diffuse, scattered light). In other words, even if Patent Owner is correct that the '553 patent's Figure 14B depicts light condensing toward the center, this is not dispositive to the proposed modification, because light reflected by a user's tissue is scattered and random, and is not collimated and perpendicular as shown in Figure 14B. Ex. 1001, Fig. 14B.

Patent Owner and Dr. Madisetti argue that "Petitioner and Dr. Kenny both admit that a convex cover condenses light towards the center of the sensor and away from the periphery," in a different petition filed against a related patent, i.e., in IPR2020-01520. PO Resp. 40–42; Ex. 2004 ¶¶ 86–87. The cited portions of the Petition and Dr. Kenny's declaration from

IPR2020-01520 discuss a decrease in the "mean path length" of a ray of light when it travels through a convex lens rather than through a flat surface. *See, e.g.*, Ex. 2020 ¶¶ 118–120. We do not agree that this discussion is inconsistent with Dr. Kenny's testimony here that, where light is reflected to the detectors at various random angles and directions, more light will reach Aizawa's symmetrically disposed detectors when travelling through the convex surface than would be reached without such a surface, because light that might have otherwise missed the detectors now will be captured. *See, e.g.*, Ex. 1047 ¶¶ 29, 30, 56, 57 ("the addition of a convex cover allows the detectors to capture some of the reflected light that otherwise would have missed them completely"). We do not discern that the convergence of a single ray of light toward the center, as discussed in IPR2020-01520, speaks to the aggregate effect on *all* light that travels through the convex surface.

We additionally do not agree with Patent Owner's argument that Petitioner's Reply presents new arguments and evidence that should have been first presented in the Petition, to afford Patent Owner an adequate opportunity to respond. *See* Sur-reply 16–19. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, for the purpose of increasing the light gathering ability of Aizawa's device. *See* Pet. 24–28. The Patent Owner Response then challenged that contention, with several arguments that Petitioner's proposed convex protrusion would not operate in the way the Petition alleges it would operate. *See* PO Resp. 39–47. This opened the door for Petitioner to provide, in the Reply, arguments and evidence attempting to rebut the contentions in the Patent Owner Response. *See* PTAB Consolidated Trial Practice Guide

(Nov. 2019) ("Consolidated Guide"),[6] 73 ("A party also may submit rebuttal evidence in support of its reply."). This is what Petitioner did here. The Reply does not change Petitioner's theory for obviousness; rather, the Reply presents more argument and evidence in support of the same theory for obviousness presented in the Petition. *Compare* Pet. 24–28, *with* Pet. Reply 20–27.

Rationale 3

Petitioner further contends that a person of ordinary skill in the art would have recognized that a cover with a protruding convex surface, such as that taught by Ohsaki, would "protect the elements within the sensor housing" of Aizawa. Pet. 44–45. We are persuaded that adding a convex cover, such as that taught by Ohsaki, would also protect the sensor's internal components in a manner similar to Aizawa's flat acrylic plate. Ex. 1003 ¶ 87; *see also* Ex. 1008 ¶ 15 (noting that a cover "protect[s] the LED or PD").

We disagree with Patent Owner's fourth argument that a person of ordinary skill in the art would not have modified Aizawa as proposed because a convex cover would be prone to scratches and because other alternatives existed. Patent Owner's counsel did not dispute, during the oral hearing, that a convex cover would indeed serve to protect the internal sensor components in Aizawa, as Petitioner proposes. Tr. 64:6–65:5 (but noting that a flat cover would also protect, and would be less prone to scratches). Even if a convex cover seated against the skin may be more prone to scratches than Aizawa's flat cover, this is one of numerous

[6] Available at https://www.uspto.gov/TrialPracticeGuideConsolidated.

tradeoffs that a person of ordinary skill in the art would consider, in determining whether the benefits of increased adhesion, signal strength, and protection outweigh the potential for a scratched cover. *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006). The totality of the final record does not support that the possibility of scratches alone would have dissuaded a person of ordinary skill in the art from the proposed modification, to achieve the benefits identified by Petitioner.

For the foregoing reasons, we are persuaded by Petitioner's contentions.

vi. Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

5. Independent Claims 10 and 20

Independent claims 10 and 20 consists of limitations that are substantially similar to elements [a]–[d] of claim 1. *Compare* Ex. 1001, 44:50–44:67, *with id.* at 45:35–47, 46:22–46. In asserting that claims 10 and 20 also would have been obvious over the combined teachings of Aizawa, Inokawa, and Ohsaki, Petitioner refers to the same arguments presented as to claim 1, except for a few unique limitations. *See* Pet. 56–62, 57 (providing explanation for how the art teaches the "planar surface" required by claim 10), 69–72 (describing how the art teaches "positioning the photodetectors 22 within a space formed by the substrate, the wall, and the cover" required by claim 20).

Patent Owner relies on the same arguments discussed above regarding claim 1. PO Resp. 10–55.

For the same reasons discussed above, and for the reasons provided by Petitioner for the unique limitations, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 10 and 20 would have been obvious over the cited combination of references.

6. Dependent Claims 2–6, 9, 11–18, 21–24, and 29

Petitioner also contends that claims 2–6, 9, 11–18, 21–24, and 29 would have been obvious based on the same combination of prior art addressed above. These challenged claims all depend directly or indirectly from independent claim 1, 10, or 20. Petitioner identifies teachings in the prior art references that teach the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 46–55, 62–68, 72–74. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 153–175, 195–223, 240–252.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 54–55 ("[T]he Petition fails to establish that independent claims 1, 10, and 20 are obvious over the cited references of Ground 1 and therefore fails to establish obviousness of any of the challenged dependent claims.").

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–6, 9, 11–18, 21–24, and 29 would have been obvious over the combined teachings of Aizawa, Inokawa, and Ohsaki for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny.

7. Conclusion

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 1–6, 9–18, 20–24, and 29 would have been obvious over the cited combination of references.

E. Obviousness over the Combined Teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006

Petitioner contends that claims 7 and 19 of the '553 patent would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006. Pet. 75–94; *see also* Pet. Reply 31–34. Patent Owner disagrees. PO Resp. 55–58; *see also* Sur-reply 26–27.

Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of the evidence that claims 7 and 19 are unpatentable.

1. Mendelson-2006 (Ex. 1010)

Mendelson-2006 is a journal article titled "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," and discloses a wireless wearable pulse oximeter connected to a personal digital assistant ("PDA"). Ex. 1010, 1.[7]

Figure 1 of Mendelson-2006 is reproduced below.

[7] Petitioner cites to the page numbers added to Exhibit 1010, rather than the native page numbering that accompanies the article. *See, e.g.*, Pet. 75. We follow Petitioner's numbering scheme.

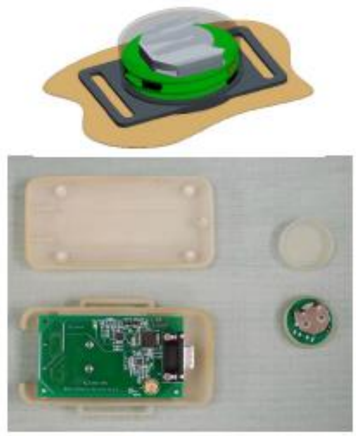


Figure 1 illustrates a sensor module attached to the skin (top), and a photograph of a disassembled sensor module and receiver module (bottom). The sensor module includes an optical transducer, a stack of round printed circuit boards, and a coin cell battery. *Id.* at 2.

Figure 2 of Mendelson-2006 is reproduced below.

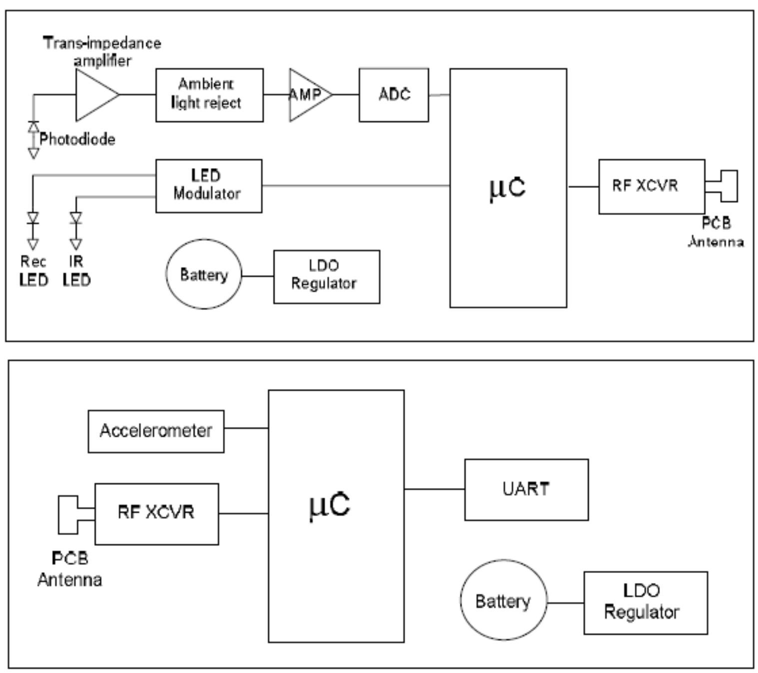


Figure 2 depicts a system block diagram of the wearable, wireless, pulse oximeter including the sensor module (top) and the receiver module (bottom). *Id.* The sensor module includes at least one light-emitting diode

("LED"), a photodetector, signal processing circuitry, an embedded microcontroller, and an RF transceiver. *Id.* at 1–2. Mendelson-2006 discloses that a concentric array of discrete photodetectors could be used to increase the amount of backscattered light detected by a reflectance type pulse oximeter sensor. *Id.* at 4. The receiver module includes an embedded microcontroller, an RF transceiver for communicating with the sensor module, and a wireless module for communicating with the PDA. *Id.* at 2.

As a PDA for use with the system, Mendelson-2006 discloses "the HP iPAQ h4150 PDA because it can support both 802.11b and Bluetooth™ wireless communication" and "has sufficient computational resources." *Id.* at 3. Mendelson-2006 further discloses that

> [t]he use of a PDA as a local terminal also provides a low-cost touch screen interface. The user-friendly touch screen of the PDA offers additional flexibility. It enables multiple controls to occupy the same physical space and the controls appear only when needed. Additionally, a touch screen reduces development cost and time, because no external hardware is required . . . . The PDA can also serve to temporarily store vital medical information received from the wearable unit.

Id.

The PDA is shown in Figure 3 of Mendelson-2006, reproduced below.

Figure 3 illustrates a sample PDA and its graphical user interface ("GUI"). *Id.* Mendelson-2006 explains that the GUI allows the user to interact with

the wearable system. *Id.* "The GUI was configured to present the input and output information to the user and allows easy activation of various functions." *Id.* "The GUI also displays the subject's vital signs, activity level, body orientation, and a scrollable PPG waveform that is transmitted by the wearable device." *Id.* For example, the GUI displays numerical oxygen saturation ("SpO_2") and heart rate ("HR") values. *Id.*

2. Dependent Claims 7 and 19

Claims 7 and 19 additionally require "one or more processors configured to" receive either data or one or more signals from the detectors and output physiological measurement information to "a touchscreen display or mobile phone." Ex. 1001, 45:17–28, 46:11–21. Petitioner contends that it would have been obvious for a person of ordinary skill in the art to have modified the sensor system of Aizawa-Inokawa-Ohsaki to integrate processors and a touchscreen display as taught by Mendelson-2006. Pet. 77–94.

Petitioner's Contentions

Petitioner notes that Aizawa's pulse rate detector is communicably connected to and transmits pulse wave data to a display designed for displaying pulse rate data. Pet. 77 (citing Ex. 1006 ¶¶ 15, 23, 28). Petitioner contends that although the display is not depicted, a person of ordinary skill in the art would have found it obvious to implement the display as a touch-screen display. *Id.* Relying on Dr. Kenny, Petitioner argues that "physiological monitoring devices commonly employed touch-screen displays" as of 2008. *Id.* (citing Ex. 1003 ¶ 255). Petitioner relies on Mendelson-2006's pulse oximetry system that includes a sensor module that

transmits signals wirelessly to a PDA through a receiver module. Pet. 77–78 (citing Ex. 1010, 2–4, Figs. 1–3). Petitioner reasons that a person of ordinary skill in the art would have been motivated to look to Mendelson-2006 for details regarding data transmission and display using the Aizawa-Inokawa-Ohsaki sensor. Pet. 78–79 (citing Ex. 1003 ¶ 258). Petitioner argues that signals acquired by Mendelson-2006's sensor module are received by the embedded microcontroller where software filters the signals to compute oxygen saturation and heart rate. *Id.* Mendelson-2006 teaches that information acquired by the sensor module is transmitted wirelessly via an RF link over to a body-worn receiver module, and Petitioner relies on the data processed by the receiver module as being "transmitted wirelessly to a PDA." Pet. 79 (quoting Ex. 1010, 2).

According to Petitioner, a person of ordinary skill in the art would have enabled transfer of information pertaining to physiological and wellness parameters through wireless communication with the handheld PDA taught by Mendelson-2006 to enhance a provider's ability "to extend more effective medical care, thereby saving the lives of critically injured persons." Pet. 80 (citing Ex. 1010, 2; Ex. 1003 ¶ 261). Petitioner contends that a person of ordinary skill in the art "would have been motivated to implement Aizawa's pulse wave sensor as part of a physiological measurement system including a handheld computing device, and to enable a physiological sensor device including sensor 1 to communicate wirelessly with the handheld computing device." Pet. 81 (citing e.g., Ex. 1003 ¶ 262). Petitioner touts many advantages of the combination that a person of ordinary skill in the art would have recognized, including the benefit of incorporating Mendelson-2006's disclosure of a PDA with a touch-screen

display and "simple GUI" to present "information to the user" and provide "easy activation of various functions," into the Aizawa-Inokawa-Ohsaki sensor. Pet. 82 (citing Ex. 1010, 4).

Petitioner identifies teachings in the prior art references that teach or suggest the limitations of each of dependent claims 7 and 19, as well as the claims as a whole. Pet. 83–94. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 263–297.

<u>Patent Owner's Contentions</u>

Patent Owner disputes Petitioner's contentions. Patent Owner argues that Petitioner's proposed combination is rooted in hindsight and results in a more complicated system. PO Resp. 55–57. Patent Owner contends that "Petitioner's addition of Mendelson-2006's wireless approach makes no sense given that—as discussed above—Petitioner's combination already replaced Aizawa's wireless transmitter with Inokawa's base station approach." *Id.* at 56–57 (citing Ex. 2004 ¶ 119). Patent Owner characterizes Petitioner's combination as requiring a person of ordinary skill in the art to:

> (1) eliminate Aizawa's existing transmitter so the resulting device will not require "a separate RF circuit" (Pet. 24); (2) change Aizawa's structure to add a second LED to transmit data using a base station, which would also require that a user remove the sensor before any data transfer can occur and thus eliminate the ability to display data in real-time (Pet. 22-24); and then (3) add back in a separate communications circuit based on Mendelson-2006 to send data to a PDA with a touch screen display (Pet. 78-81, 85-86), thereby restoring the real-time display functionality original[ly] included in Aizawa's sensor.

Id. at 57 (citing, e.g., Ex. 2004 ¶¶ 119–120). Patent Owner further argues that such a modification eliminates the desired real-time monitoring

employed by Mendelson-2006. *Id.* (citing Ex. 2004 ¶¶ 113, 115).[8] As argued by Patent Owner, a person of ordinary skill in the art looking to integrate a touch-screen display with Aizawa "would not bother with Inokawa's base station approach when Mendelson 2006 uses the same type of dedicated transmission circuit already present in Aizawa." Sur-reply 27.

Analysis

As discussed above, we determine that Petitioner demonstrates sufficiently that a person of ordinary skill in the art would have been motivated to modify Aizawa to include an additional LED to, *inter alia*, allow for wireless transmission of sensed pulse rate and motion data to a base device. Although Aizawa discloses transmission of data for display (Ex. 1006 ¶¶ 15, 35), Aizawa is silent as to how the data is transmitted or displayed. In light of the combination with Inokawa, therefore, Aizawa's multiple LEDs would have allowed wireless transmission of data to a base device. *See, e.g.*, Ex. 1008 ¶ 76 ("[V]ital sign information stored in the memory 63, such as pulse and body motion, is transmitted to the base device 17 using the S-side infrared LED 23 of the pulse sensor 1 and the B-side PD 45 of the base device 17."). Inokawa further discloses that the base device, once it receives information from the sensor, "transmits this information to the PC 59." *Id.* ¶ 75; *see also id.* ¶¶ 67, 77.

With this backdrop, we are persuaded by Petitioner's contention that a person of ordinary skill in the art would have been motivated to implement

[8] We do not address Patent Owner's argument that Mendelson-2006 does not disclose a "multi-emitter/multi-detector sensor" because Mendelson-2006 is not relied upon for such limitations. PO Resp. 56.

the physiological sensor device resulting from the combined teachings of Aizawa, Inokawa, and Ohsaki as part of a physiological measurement system that includes a touchscreen display or mobile phone as further taught by Mendelson-2006. Indeed, Aizawa and Inokawa already teach the desirability of transmitting sensed data to, e.g., a computer or a display, although neither discloses further detail. *See, e.g.*, Ex. 1006, 15; Ex. 1008 ¶ 75; *see also* Ex. 1047 ¶ 66 (Aizawa "is silent about how such transmission would be implemented."). In light of these teachings, we credit Dr. Kenny's testimony that transmitting sensed data wirelessly to a handheld computing device, as taught by Mendelson-2006, would have achieved the identified benefits of, e.g., providing a low-cost display with a simple user interface and easy activation of functions (Ex. 1003 ¶¶ 66, 257) and the ability to provide more effective medical care when the handheld device is carried by first responders (*id.* ¶ 261). *See, e.g.*, *id.* ¶¶ 253–264; Ex. 1047 ¶¶ 64–70. We are also persuaded that this would have been within the skill level of an ordinary artisan and would have achieved predictable results. Ex. 1003 ¶ 280 ("would have led to predictable results without altering or hindering the functions performed by the sensor," including "implement[ing] the well-known technique of connecting a physiological sensor to a handheld device to cause Aizawa-Inokawa-Ohsaki's sensor to include such features to achieve the predictable benefits offered by Mendelson 2006").

We do not agree with Patent Owner's characterization of the proposed combination. Petitioner does not propose "(1) eliminat[ing] Aizawa's existing transmitter . . . (2) chang[ing] Aizawa's structure to add a second LED to transmit data using a base station . . .; and then (3) add[ing] back in a separate communications circuit to the base station." PO Resp. 57. As

discussed above, Petitioner proposes that the system suggested by, *inter alia*, Aizawa and Inokawa—which includes a sensor in communication with a base device, and which contemplates additional communication from the base device to a PC—further includes a handheld computing device in wireless communication with that system. In other words, Petitioner's proposed combination effectively replaces or supplements Inokawa's PC 59 with a PDA, such as that taught by Mendelson-2006. Thus, in Petitioner's proposed combination, physiological data is sensed by Aizawa's sensor, transmitted to a base device through an additional LED, as taught by Inokawa, and further transmitted to, *inter alia*, a PDA, as taught by Mendelson-2006. *See, e.g.*, Pet. 77–83. Indeed, both Aizawa and Inokawa expressly contemplate transmission to an additional computing device (*see, e.g.*, Ex. 1006, 15; Ex. 1008 ¶ 75); Petitioner's proposed modification merely states that such transmission occurs wirelessly to a handheld device. The record supports this contention.

We have considered Dr. Madisetti's testimony, but it is based on the same mischaracterization put forth by Patent Owner. Ex. 2004 ¶¶ 118–120 (mischaracterizing the combination). Notwithstanding this misrepresentation of the proposed modification, Dr. Madisetti does not dispute Dr. Kenny's testimony that wireless transmission to a handheld computing device would have achieved the identified benefits, such as a low-cost device that improves medical care. *See id.* As such, we credit Dr. Kenny's unrebutted testimony.

Patent Owner and Dr. Madisetti further criticize the combination, asserting that Mendelson-2006's wireless transmission exists to allow real-time monitoring, which is impossible where a sensor must be mounted on a

base device to transfer information through LEDs. *Id.* ¶ 119; *see also* PO Resp. 56–57. However, the lack of real-time measurement and transmission is simply one consideration among many. As noted in Inokawa, real-time wireless communication has its drawbacks. Ex. 1008 ¶ 5. We discern that a skilled artisan would have weighed these competing interests. "[A] given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine." *Medichem*, 437 F.3d at 1165 (citation omitted).

Further, as to the limitations of claims 7 and 19, the cited evidence supports Petitioner's contention that Mendelson-2006 describes wirelessly transmitting vital physiological information acquired from a sensor to a PDA, which receives it. Pet. 85–88; *see, e.g.*, Ex. 1010, 1, 2 ("The PDA can monitor multiple wearable pulse oximeters simultaneously and allows medics to collect vital physiological information to enhance their ability to extend more effective care to those with the most urgent needs."), 3 (explaining that the PDA "has sufficient computational resources for the intended application" and "can also serve to temporarily store vital medical information received from the wearable unit"), 3 ("The [PDA's graphical user interface] also displays the subject's vital signs, activity level, body orientation, and a scrollable PPG waveform that is transmitted by the wearable device."), Fig. 3 (displaying SpO_2 and HR data); Ex. 1003 ¶¶ 179–180. As discussed above, Petitioner's proposed combination involves transmission of sensed data from Aizawa's physiological sensor to a base device, as taught by Inokawa, and further wireless transmission of that data from the base device to a handheld computing device, such as a PDA.

Claim 19 requires the "output of information indicative of measurements of the physiological parameter to" the touch-screen display or mobile phone. Ex. 1001, 46:19–21. The cited evidence further supports Petitioner's contention that Mendelson-2006 describes a PDA with a touchscreen display configured to display indicia responsive to measurements of, e.g., SpO_2 and HR. Pet. 85–88, 93; Ex. 1003 ¶ 297; *see, e.g.*, Ex. 1010, 3 ("The use of a PDA . . . also provides a low-cost touch screen interface.").

3. Conclusion

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 7 and 19 would have been obvious over the cited combination of references.

F. Obviousness over the Combined Teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Sherman

Petitioner contends that claims 8 and 25–28 of the '553 patent would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Sherman. Pet. 94–101; *see also* Pet. Reply 35–38. Patent Owner disagrees. PO Resp. 55–58; *see also* Sur-reply 27–29.

Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of the evidence that claims 8 and 25–28 are unpatentable.

1. Sherman (Exhibit 1011)

Sherman is a patent titled "Magnetic Clasp for Wristwatch Strap," and it relates to use of magnetizable material embedded in thermoplastic material with rows of alternating magnetic poles. Ex. 1011, codes (54), (57). Sherman discloses a magnetic fastening mechanism for "wrist instruments,"

such as wristwatches. *Id.* at 1:4–10. Sherman's system provides "an improved clasp for a flexible strap which eliminates buckles or other types of protruding mechanisms" and is "secured, yet easy to engage when desired." *Id.* at 2:1–11. As shown below in Figure 2 of Sherman, the mechanism includes a pair of flexible strap ends having "permanently magnetizable material" of opposite polarities in addition to "mutually nesting uniformly spaced protuberances and indentations." *Id.* at 2:43–62, Fig. 2.

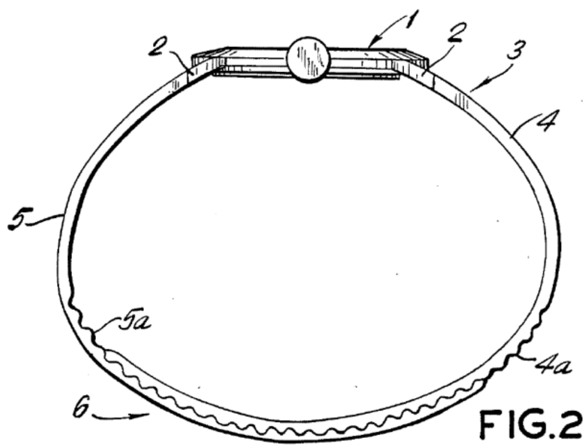


FIG.2

Figure 2 of Sherman depicts an end elevational view showing the wristwatch and strap with transverse ridges 4a and 5a incorporating magnetic securing materials. *Id.*

2. Dependent Claims 8 and 25–28

Claims 8 and 25–28 add only one substantive common feature not addressed previously and that is "a magnet configured to be used as a connecting mechanism." Ex. 1001, 45:29–32 (claim 8), 46:66–67 (claim 25), 47:1–19 (claims 26–28 depending from claim 25). Petitioner contends that it would have been obvious for a person of ordinary skill in the art to have modified the sensor system of Aizawa-Inokawa-Ohsaki-

Mendelson-2006 to integrate a magnetic connection as taught by Sherman. Pet. 94–100.

Petitioner's Contentions

Petitioner contends that "[t]he Aizawa-Inokawa-Ohsaki-Mendelson-2006 sensor does not describe the mechanism for closing the attachment strap 7 that fastens the sensor onto the subject's wrist, but a POSITA would have been motivated to look to other wearable, and specifically wrist worn, devices such as Sherman, for details regarding a mechanism for fastening the sensor to the subject's wrist." Pet. 96 (citing Ex. 1003 ¶ 300). Petitioner contends a person of ordinary skill in the art would have been motivated to add Sherman's magnetic connection in order to be more visually appealing, prevent corners from catching upon clothing, and to prevent broken connectors or accidental snagging. Pet. 96 (citing Ex. 1011, 1:11–24; Ex. 1003 ¶ 301).

Patent Owner's Contentions

Patent Owner disputes Petitioner's contentions. Patent Owner argues that Petitioner's proposed combination relies on Sherman solely for its alleged disclosure of a magnetic connector, but Ohsaki already includes a series of dedicated belts designed to exert a specific pressure on the user's wrist. PO Resp. 57 (citing Ex. 1009 ¶18). Patent Owner alleges that a person of ordinary skill in the art would have understood that any advantage from Ohsaki's convex board would also require Ohsaki's specific attachment arrangement, which includes belts and a cushion to prevent movement, yet, Petitioner does not explain how Sherman would have allowed consistent attachment pressure for its sensor as required by Ohsaki.

Id. at 57–58 (citing Ex. 1009 ¶ 18); *see also* Sur-reply 28 ("But Ohsaki teaches a specialized attachment mechanism having specific features to 'stably fix[]' the detecting element to the wrist and improve signal-to-noise."). Thus, Patent Owner contends that the person of ordinary skill in the art would not have been motivated to incorporate Sherman's magnetic attachment mechanism into Petitioner's proposed combination. *Id.* at 58 (citing Ex. 2004 ¶ 122); *see also* Sur-reply 28 ("Aizawa's silence about what strap to use for its ***flat*** sensor is irrelevant," because Ohsaki's arrangement stably fixes a convex surface.).

<u>Analysis</u>

We are persuaded by Petitioner's evidence and argument that a person of ordinary skill in the art would have been motivated to combine Sherman's teaching of a magnetic connection in the existing combination of references. We find persuasive Dr. Kenny's testimony that a person of ordinary skill in the art would have understood from Ohsaki itself that a cushion designed to exert a specific pressure is not required to obtain the benefits described in relation to Ohsaki's board. Ex. 1047 ¶¶ 71–72 (noting that "Ohsaki's independent claims 1, 3, and 5 do not recite a cushion") (citing Ex. 1009, claims 1–3, 5–7). Further, we are persuaded by Dr. Kenny's testimony that a person of ordinary skill in the art "would have understood that a cover with a convex protrusion would have provided the benefits taught by Ohsaki with any suitable strap, and in considering Ohsaki's teachings in relation to Aizawa, would have found it obvious to employ Sherman's magnetic connector." *Id.* ¶ 72. In light of the totality of the record, including Dr. Kenny's testimony, we determine that a person of ordinary skill in the art would have been motivated to employ Sherman's magnetic connector

because the pressure range required for Ohsaki's benefits could be achieved by any number of connection fastening mechanisms. *See id.*

Further, Patent Owner's arguments do not persuasively address Petitioner's proposed combination. *See* Pet. 24–28, 94–98. Ohsaki was relied upon for its teaching that a convex surface protruding into a user's skin will, *inter alia*, prevent slippage. *See id.*; *see also* Ex. 1047 ¶ 73; Ex. 1009, 25, Figs. 4A, 4B. As discussed above, we found persuasive Dr. Kenny's testimony that a person of ordinary skill in the art would have had reason, in view of that teaching, to modify the Aizawa's sensor's flat cover to include a protrusion, so as to improve adhesion between the user's wrist and the sensor's surface, improve detection efficiency, and protect the elements within the sensor housing. *See* Ex. 1003 ¶¶ 84–91. The resulting sensor features Aizawa's cover modified in view of Ohsaki, not Ohsaki's translucent board. Ex. 1047 ¶ 73 ("the resulting sensor features Aizawa's cover modified in view of Ohsaki, not Ohsaki's translucent board 8"). Likewise, Patent Owner does not effectively rebut Dr. Kenny's testimony that a person of ordinary skill in the art would have integrated a magnetic connector in the combination of references in view of Sherman for reasons related to engagement and user comfort. *See* PO Resp. 57–58; Ex. 1047 ¶¶ 73, 74 ("obvious in view of Sherman's teachings to incorporate a magnetic connector, both for ease of engagement and user comfort"); Ex. 1003 ¶¶ 300–303.

3. Conclusion

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 8 and 25–28 would have been obvious over the cited combination of references.

III. CONCLUSION

In summary:[9]

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–6, 9–18, 20–24, 29	103	Aizawa, Inokawa, Ohsaki	1–6, 9–18, 20–24, 29	
7, 19	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006	7, 19	
8, 25–28	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006, Sherman	8, 25–28	
Overall Outcome			1–29	

[9] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–29 of the ’553 patent have been shown to be unpatentable;

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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U.S. DEPARTMENT OF COMMERCE
UNITED STATES PATENT AND TRADEMARK OFFICE

May 23, 2022

THIS IS TO CERTIFY that the attached document is a list of the papers that comprise the record before the Patent Trial and Appeal Board (PTAB) for the *Inter Partes* Review proceeding identified below.

APPLE INC.,

Petitioner,

v.

MASIMO CORPORATION,

Patent Owner.

____

Case No.: IPR2020-01538
United States Patent No.: 10,588,554 B2

____

By authority of the
DIRECTOR OF THE UNITED STATES
PATENT AND TRADEMARK OFFICE

/s/ Mekbib Solomon
Certifying Officer

PROSECUTION HISTORY FOR *INTER PARTES* REVIEW NO.: IPR2020-01538

DATE	DESCRIPTION
09/02/2020	Petition for *Inter Partes* Review
09/02/2020	Petitioner's Power of Attorney
09/02/2020	Petitioner's Notice Ranking Petitions and Explaining Material Differences
09/17/2020	Notice of Filing Date Accorded
09/21/2020	Patent Owner's Mandatory Notices
11/04/2020	Petitioner's Updated Exhibit List
12/17/2020	Patent Owner's Notice of Waiver of Preliminary Response
03/02/2021	Decision - Institution of *Inter Partes* Review Proceeding
03/02/2021	Scheduling Order
03/16/2021	Patent Owner's Objections to Admissibility of Petitioner's Evidence Submitted Before Trial Institution
04/08/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
04/14/2021	Stipulation Modifying Due Dates
04/16/2021	Patent Owner's Motion for *Pro Hac Vice* Admission – Jeremiah Helm
04/16/2021	Patent Owner's Motion for *Pro Hac Vice* Admission – William Zimmerman
04/16/2021	Patent Owner's Updated Exhibit List
04/20/2021	Decision Granting Patent Owner's Motions for *Pro Hac Vice* Admission
04/20/2021	Patent Owner's Amended Notice of Deposition - Thomas W. Kenny
04/21/2021	Patent Owner's Updated Mandatory Notice
04/21/2021	Patent Owner's Supplemental Power of Attorney – W. Zimmerman and J. Helm
04/22/2021	Petitioner's Motion to Submit Supplemental Information
05/06/2021	Order Granting Petitioner's Motion to Submit Supplemental Information
05/14/2021	Petitioner's Submission of Supplemental Information
06/08/2021	Patent Owner's Response
06/11/2021	Petitioner's Objections to Evidence
06/15/2021	Petitioner's Objections to Evidence
07/19/2021	Petitioner's Notice of Deposition - Vijay K. Madisetti
08/31/2021	Petitioner's Reply to Patent Owner's Response
09/07/2021	Petitioner's Objections to Evidence
09/09/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
09/13/2021	Petitioner's Updated Mandatory Notice
09/14/2021	Patent Owner's Updated Notice of Deposition - Thomas W. Kenny
10/12/2021	Patent Owner's Sur-Reply
10/19/2021	Petitioner's Objections to Evidence
10/22/2021	Petitioner's Request for Oral Hearing
10/22/2021	Patent Owner's Oral Argument Request
10/28/2021	Patent Owner's Supplemental Mandatory Notices
11/01/2021	Order Setting Oral Argument
11/22/2021	Petitioner's Identification of Testimony

DATE	DESCRIPTION
12/03/2021	Patent Owner's Demonstratives for Trial Hearing
12/03/2021	Petitioner's Updated Exhibit List
01/06/2022	Oral Hearing Transcript
02/23/2022	Final Written Decision
04/12/2022	Notice of Appeal

Trials@uspto.gov
571-272-7822

Paper 43
Entered: February 23, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

IPR2020-01538
Patent 10,588,554 B2

Before GEORGE R. HOSKINS, ROBERT L. KINDER, and AMANDA F. WIEKER, *Administrative Patent Judges.*

WIEKER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

Apple Inc. ("Petitioner") filed a Petition requesting an *inter partes* review of claims 1–7 and 20–28 ("challenged claims") of U.S. Patent No. 10,588,554 B2 (Ex. 1001, "the '554 patent"). Paper 3 ("Pet."). Masimo Corporation ("Patent Owner") waived filing a Preliminary Response. Paper 7. We instituted an *inter partes* review of all challenged claims 1–7 and 20–28 on the sole asserted ground of unpatentability, pursuant to 35 U.S.C. § 314. Paper 8 ("Inst. Dec.").

After institution, Patent Owner filed a Response (Paper 23, "PO Resp.") to the Petition, Petitioner filed a Reply (Paper 27, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 32, "PO Sur-reply").[1] An oral hearing was held on December 7, 2021, and a transcript of the hearing is included in the record. Paper 42 ("Tr.").

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, Petitioner has met its burden of showing, by a preponderance of the evidence, that challenged claims 1–7 and 20–28 of the '554 patent are unpatentable.

B. Related Proceedings

The parties identify the following matters related to the '554 patent:

Masimo Corporation v. Apple Inc., Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

[1] After the Sur-reply was filed, we authorized Petitioner to file an Identification of Testimony. Paper 38.

Apple Inc. v. Masimo Corporation, IPR2020-01539 (PTAB Sept. 2, 2020) (also challenging claims 1–28 of the ’554 patent);

Apple Inc. v. Masimo Corporation, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2); and

Apple Inc. v. Masimo Corporation, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2).

Pet. 3–4; Paper 5, 1–3.

Patent Owner further identifies the following pending patent applications, among other issued and abandoned applications, that claim priority to, or share a priority claim with, the ’554 patent:

U.S. Patent Application No. 16/834,538;

U.S. Patent Application No. 16/449,143; and

U.S. Patent Application No. 16/805,605.

Paper 5, 1–2.

C. The '554 Patent

The '554 patent is titled "Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents," and issued on March 17, 2020, from U.S. Patent Application No. 16/544,713, filed August 19, 2019. Ex. 1001, codes (21), (22), (45), (54). The '554 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The '554 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:38–40. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:29–35, 64–65. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:45–48.

Figure 1 of the '554 patent is reproduced below.

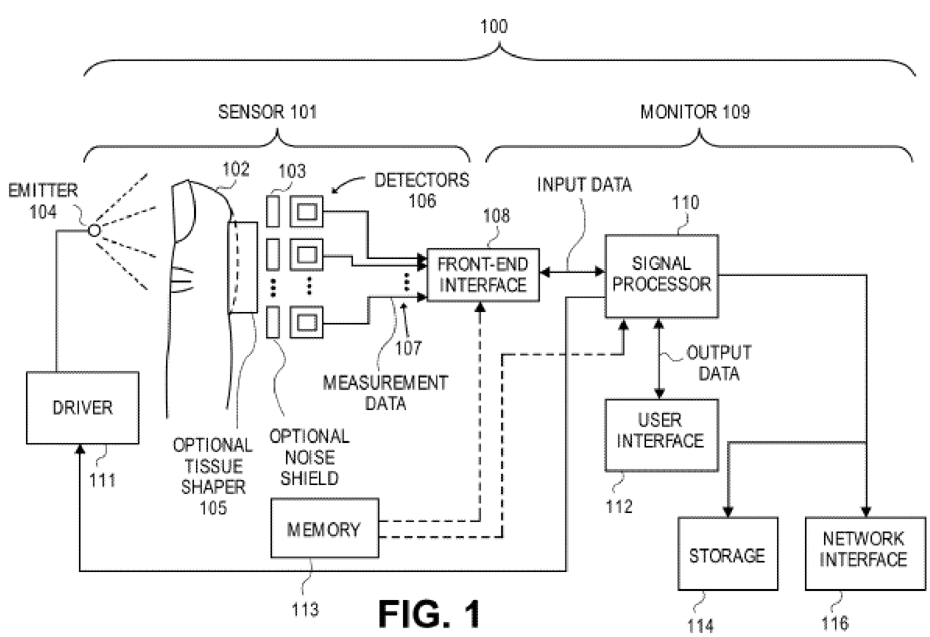

FIG. 1

Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:47–58. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* at 11:59–63. Emitters 104 emit light that is attenuated or reflected by the patient's tissue at measurement site 102. *Id.* at 14:3–7. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light, detectors 106 output detector signals 107 to monitor 109 through front-end interface 108. *Id.* at 14:7–10, 26–32. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 11:2–14.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:16–18. "[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals received from the detectors." *Id.* at 15:21–24. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:46–56. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 15:60–16:11.

The '554 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate detector portions of sensor devices.

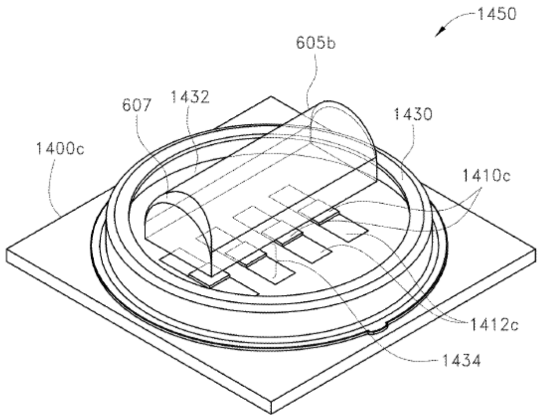

FIG. 14D

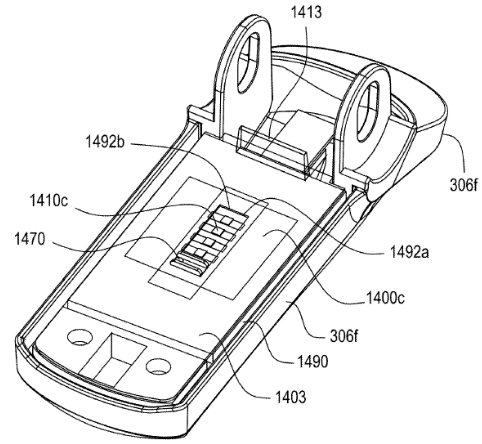

FIG. 14F

Figure 14D illustrates portions of a detector submount and Figure 14F illustrates portions of a detector shell. *Id.* at 6:44–47. As shown in Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 35:36–39, 36:30–37. Figure 14F illustrates a detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 37:9–17. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* Alternatively, cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:47–48.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.

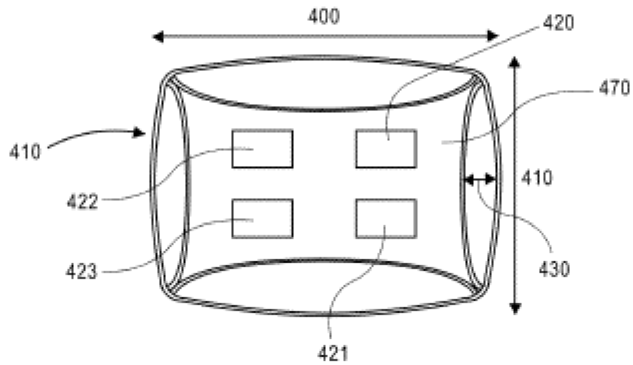

FIG. 4A

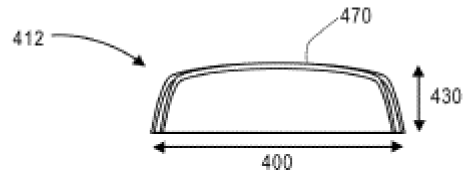

FIG. 4B

Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:18–24. "[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site." *Id.* "For example, . . . measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site." *Id.* at 23:39–43. The measurement site contact area may include windows 420–423 that "mimic or approximately mimic a configuration of, or even house, a plurality of detectors." *Id.* at 23:49–63.

D. Illustrative Claim

Of the challenged claims, claims 1 and 20 are independent. Claim 1 is illustrative and is reproduced below.

1. A physiological measurement system comprising:

[a] a physiological sensor device comprising:

[b] a plurality of emitters configured to emit light into tissue of a user;

[c] at least four detectors, wherein each of the at least four detectors has a corresponding window that allows light to pass through to the detector;

[d] a wall that surrounds at least the at least four detectors; and

[e] a cover that operably connects to the wall and that is configured to be located between tissue of the user and the at least four detectors when the physiological sensor device is worn by the user, wherein:

[f] the cover comprises a single protruding convex surface, and

[g] at least a portion of the cover is sufficiently rigid to cause tissue of the user to conform to at least a portion of a shape of the single protruding convex surface when the physiological sensor device is worn by the user; and

[h] a handheld computing device in wireless communication with the physiological sensor device, wherein the handheld computing device comprises:

[i] one or more processors configured to wirelessly receive one or more signals from the physiological sensor device, the one or more signals responsive to at least a physiological parameter of the user;

[j] a touch-screen display configured to provide a user interface,

wherein:

[k] the user interface is configured to display indicia responsive to measurements of the physiological parameter, and

[l] an orientation of the user interface is configurable responsive to a user input; and

[m] a storage device configured to at least temporarily store at least the measurements of the physiological parameter.

Ex. 1001, 44:51–45:21 (bracketed identifiers a–m added). Independent claim 20 includes limitations substantially similar to limitations [a]–[h] of claim 1. *Id.* at 46:31–52.

E. Applied References

Petitioner relies upon the following references:

> Mendelson, U.S. Patent No. 6,801,799 B2, filed February 6, 2003, issued October 5, 2004 (Ex. 1012, "Mendelson-799");
>
> Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1009, "Ohsaki");
>
> Schulz et al., U.S. Patent Application Publication No. 2004/0054291 A1, filed July 31, 2003, published March 18, 2004 (Ex. 1013, "Schulz"); and
>
> Y. Mendelson et al., "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," Proceedings of the 28th IEEE EMBS Annual International Conference, 912–915 (2006) (Ex. 1010, "Mendelson-2006").

Pet. 12.

Petitioner also submits, *inter alia*, the Declaration of Thomas W. Kenny, Ph.D. (Ex. 1003) and the Second Declaration of Dr. Thomas W. Kenny (Ex. 1047). Patent Owner submits, *inter alia*, the Declaration of Dr. Vijay K. Madisetti (Ex. 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madisetti, including from this proceeding and others. *See* Exs. 1041–1043, 2006–2009, 2027.

F. Asserted Ground of Unpatentability

We instituted an *inter partes* review based on the following ground. Inst. Dec. 9, 32.

Claims Challenged	35 U.S.C. §	References/Basis
1–7, 20–28	103	Mendelson-799, Ohsaki, Schulz, Mendelson-2006

II. DISCUSSION

A. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2019). Petitioner submits that no claim term requires express construction. Pet. 11. Patent Owner submits that claim terms should be given their ordinary and customary meaning, consistent with the Specification. PO Resp. 9–10.

We agree that no claim terms require express construction. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

B. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103(a) if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness.[2] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also "determine

[2] Patent Owner has not presented objective evidence of non-obviousness.

whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must support its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

Petitioner identifies the appropriate level of skill in the art as that possessed by a person "having a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information." Pet. 10–11 (citing Ex. 1003 ¶¶ 1–18, 20–21). "Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline." *Id.* at 11.

Patent Owner makes several observations regarding Petitioner's identified level of skill in the art but, "[f]or purposes of this proceeding,

[Patent Owner] nonetheless applies Petitioner's asserted level of skill." PO Resp. 10.

We adopt Petitioner's assessment as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

D. Obviousness over the Combined Teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006

Petitioner contends that claims 1–7 and 20–28 of the '554 patent would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006. Pet. 43–96; *see also generally* Pet. Reply. Patent Owner disagrees. PO Resp. 12–63; *see also generally* PO Sur-reply.

Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of the evidence that claims 1–7 and 20–28 are unpatentable.

1. Overview of Mendelson-799 (Ex. 1012)

Mendelson-799 is a U.S. patent titled "Pulse Oximeter and Method of Operation," and discloses a sensor for non-invasive measurement of a blood parameter, which includes a sensor housing, a radiation source, and a detector. Ex. 1012, codes (54), (57).

Figure 7 of Mendelson-799 is reproduced below.

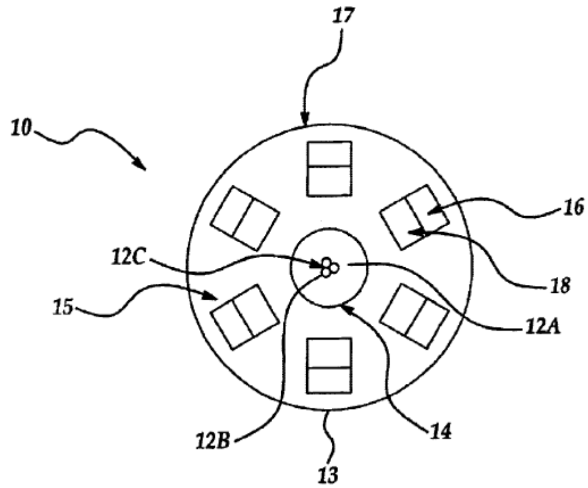

Figure 7

Figure 7 illustrates optical sensor 10 with light source 12, which includes three closely spaced light emitting elements 12a, 12b, 12c. *Id.* at 9:22–28. Optical sensor 10 includes an array of discrete detectors, i.e., "far" detectors 16 and "near" detectors 18, "arranged in two concentric ring-like arrangements . . . surrounding the light emitting elements." *Id.* at 9:29–34. "[L]ight shield 14 is positioned between the photodiodes and the light emitting elements, and prevents direct optical coupling between them, thereby maximizing the fraction of backscattered light passing through the arterially perfused vascular tissue in the detected light." *Id.* at 9:35–40. Sensor housing 17 accommodates the light source, light shield, and detectors. *Id.* at 9:34–35.

Figure 8 of Mendelson-799 is reproduced below.

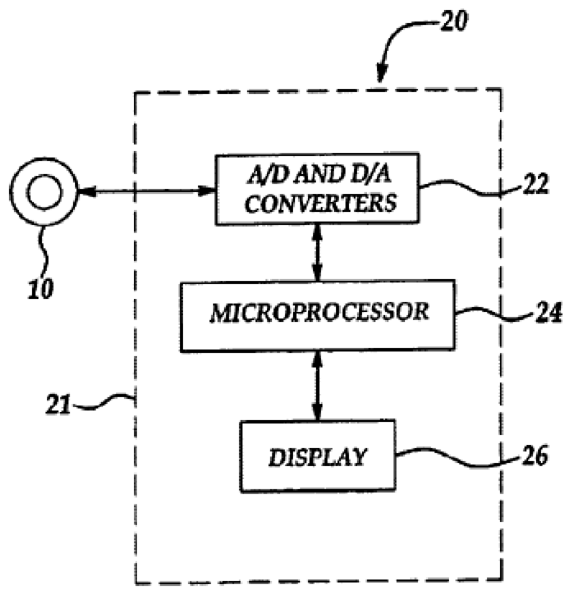

Figure 8

Figure 8 illustrates a block diagram of pulse oximeter 20 using sensor 10. *Id.* at 10:16–17. Pulse oximeter 20 includes control unit 21, with electronic block 22 connectable to sensor 10, microprocessor 24, and display 26, which presents measurement results. *Id.* at 10:17–22. "The measured data (i.e., electrical output of the sensor 10 indicative of the detected light) is directly processed in the block 22, and the converted signal 25 is further processed by the microprocessor 24." *Id.* at 10:22–25.

2. Overview of Ohsaki (Ex. 1009)

Ohsaki is a U.S. patent application publication titled "Wristwatch-type Human Pulse Wave Sensor Attached on Back Side of User's Wrist," and discloses an optical sensor for detecting a pulse wave of a human body. Ex. 1009, code (54), ¶ 3.

Figure 1 of Ohsaki is reproduced below.

FIG. 1

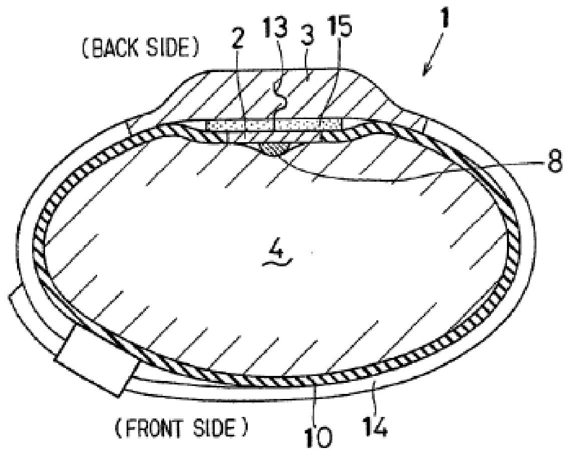

Figure 1 illustrates a cross-sectional view of pulse wave sensor 1 attached on the back side of user's wrist 4. *Id.* ¶¶ 12, 16. Pulse wave sensor 1 includes detecting element 2 and sensor body 3. *Id.* ¶ 16.

Figure 2 of Ohsaki, reproduced below, illustrates further detail of detecting element 2.

FIG. 2

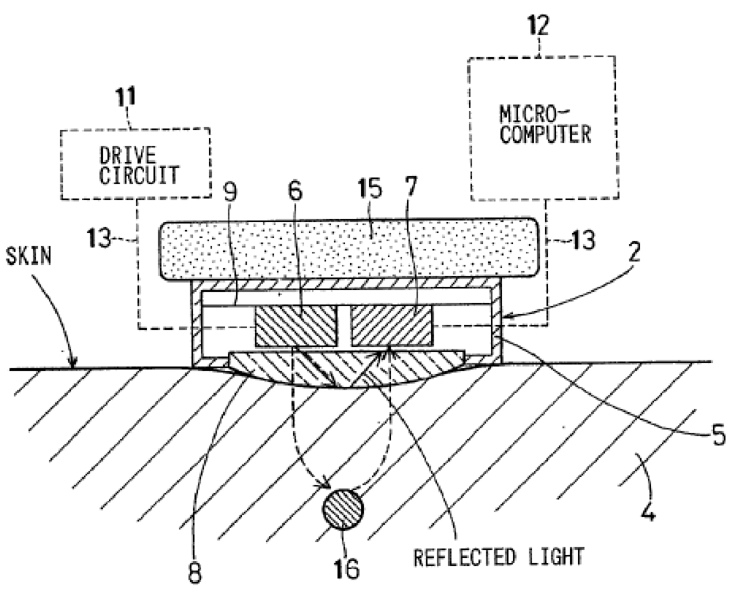

Figure 2 illustrates a mechanism for detecting a pulse wave. *Id.* ¶ 13. Detecting element 2 includes package 5, light emitting element 6, light receiving element 7, and translucent board 8. *Id.* ¶ 17. Light emitting element 6 and light receiving element 7 are arranged on circuit board 9 inside package 5. *Id.* ¶¶ 17, 19.

"[T]ranslucent board 8 is a glass board which is transparent to light, and attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8." *Id.* ¶ 17. "[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin," preventing detecting element 2 from slipping off the detecting position of the user's wrist. *Id.* ¶ 25. By preventing the detecting element from moving, the convex surface suppresses "variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin." *Id.* Additionally, the convex surface prevents penetration by "noise such as disturbance light from the outside." *Id.*

Sensor body 3 is connected to detecting element 2 by signal line 13. *Id.* ¶ 20. Signal line 13 connects detecting element 2 to drive circuit 11, microcomputer 12, and a monitor display (not shown). *Id.* Drive circuit 11 drives light emitting element 6 to emit light toward wrist 4. *Id.* Detecting element 2 receives reflected light which is used by microcomputer 12 to calculate pulse rate. *Id.* "The monitor display shows the calculated pulse rate." *Id.*

3. Overview of Schulz (Ex. 1013)

Schulz is a U.S. patent application publication titled "Pulse Oximetry Ear Sensor," and discloses an ear sensor assembly including an emitter pad and a detector pad. Ex. 1013, codes (54), (57).

Figure 19C of Schulz is reproduced below.

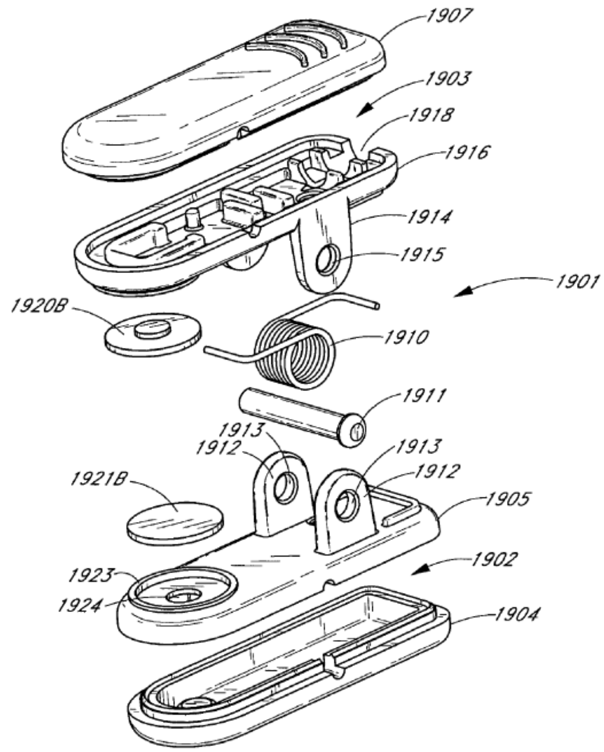

Figure 19C illustrates an exploded top perspective view of an ear sensor clip. *Id.* ¶ 31. Each sensor clip 1900 includes "opposingly positioned housings 1902 and 1903 that house one or more sensor optical components." *Id.* ¶ 65. Each housing includes respective inward facing shells 1905 and 1906.[3] *Id.* ¶ 65. "[I]nward facing shells 1905 and 1906 further include windows 1919 and 1924 that provide an aperture for transmission of optical

[3] Figure 19C appears to label inward facing shell 1906 as 1916. *See id.* at Fig. 19B.

energy to or from a tissue site. Translucent silicone material covers windows 1919 and 1924 providing lenses 1920 and 1921." *Id.* ¶ 67.

A "thin sheet of opaque material is located beneath window 1919 or 1924, and a window in the opaque material provides an aperture for transmission of optical energy to or from the tissue site." *Id.* ¶ 73. "The opaque material blocks light, and the window in the opaque material can be sized as needed to block the proper amount of light from entering the aperture to, for example, avoid saturation of the light detector." *Id.*

4. Mendelson-2006 (Ex. 1010)

Mendelson-2006 is a journal article titled "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," and discloses a wireless wearable pulse oximeter connected to a personal digital assistant ("PDA"). Ex. 1010, 1.[4]

Figure 1 of Mendelson-2006 is reproduced below.

[4] Petitioner cites to the page numbers added to Exhibit 1010, rather than the native page numbering that accompanies the article. *See, e.g.*, Pet. 23–25. We follow Petitioner's numbering scheme.

Figure 1 illustrates a sensor module attached to the skin (top), and a photograph of a disassembled sensor module and receiver module (bottom). The sensor module includes an optical transducer, a stack of round printed circuit boards, and a coin cell battery. *Id.* at 2.

Figure 2 of Mendelson-2006 is reproduced below.

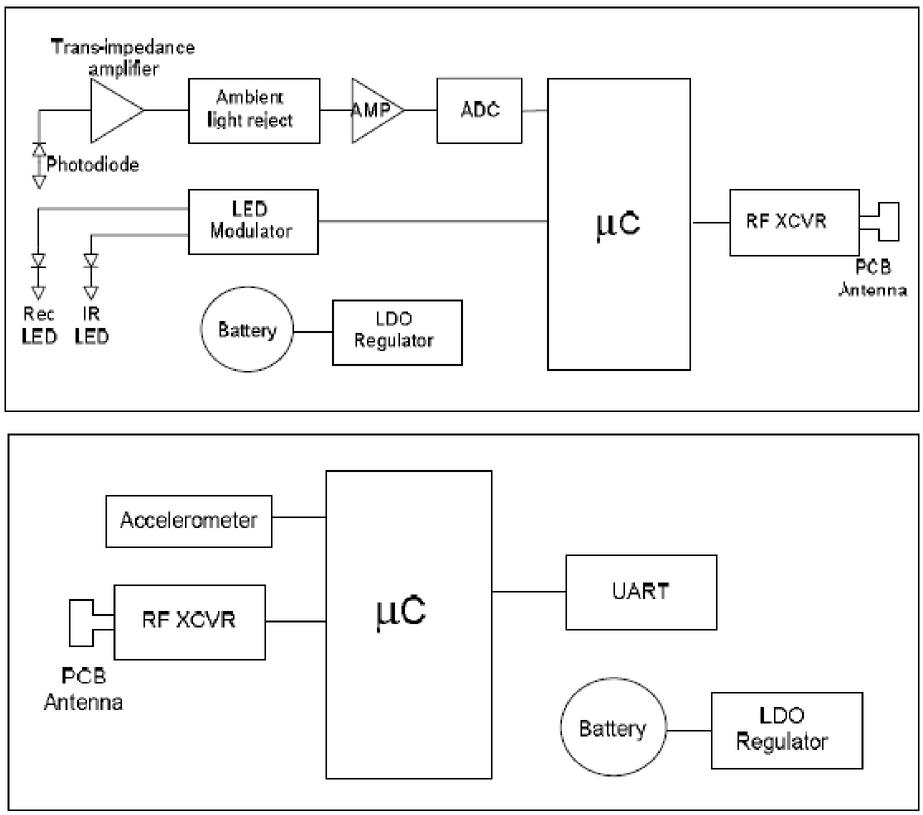

Figure 2 depicts a system block diagram of the wearable, wireless, pulse oximeter including the sensor module (top) and the receiver module (bottom). *Id.* The sensor module includes at least one light-emitting diode ("LED"), a photodetector, signal processing circuitry, an embedded microcontroller, and an RF transceiver. *Id.* at 1–2. Mendelson-2006 discloses that a concentric array of discrete photodetectors could be used to increase the amount of backscattered light detected by a reflectance type pulse oximeter sensor. *Id.* at 4. The receiver module includes an embedded

microcontroller, an RF transceiver for communicating with the sensor module, and a wireless module for communicating with the PDA. *Id.* at 2.

As a PDA for use with the system, Mendelson-2006 discloses "the HP iPAQ h4150 PDA because it can support both 802.11b and Bluetooth™ wireless communication" and "has sufficient computational resources." *Id.* at 3. Mendelson-2006 further discloses that

> [t]he use of a PDA as a local terminal also provides a low-cost touch screen interface. The user-friendly touch screen of the PDA offers additional flexibility. It enables multiple controls to occupy the same physical space and the controls appear only when needed. Additionally, a touch screen reduces development cost and time, because no external hardware is required. . . . The PDA can also serve to temporarily store vital medical information received from the wearable unit.

Id.

The PDA is shown in Figure 3 of Mendelson-2006, reproduced below.

Figure 3 illustrates a sample PDA and its graphical user interface ("GUI"). *Id.* Mendelson-2006 explains that the GUI allows the user to interact with the wearable system. *Id.* "The GUI was configured to present the input and output information to the user and allows easy activation of various functions." *Id.* "The GUI also displays the subject's vital signs, activity

level, body orientation, and a scrollable PPG waveform that is transmitted by the wearable device." *Id.* For example, the GUI displays numerical oxygen saturation ("SpO_2") and heart rate ("HR") values. *Id.*

5. Independent Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006. Pet. 43–69. Below, we set forth how the combination of prior art references teaches or suggests the claim limitations that are not disputed by the parties. For those limitations and reasons for combining the references that are disputed, we examine each of the parties' contentions and then provide our analysis.

i. "A physiological measurement system comprising"

The cited evidence supports Petitioner's undisputed contention that the combination of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006 satisfies the subject matter of the preamble.[5] Pet. 43–45; *see, e.g.*, Ex. 1012, code (57), 7:25–8:13, 8:37–41, 9:22–40, 10:16–22, Fig. 7 (sensor device), 8; Ex. 1010, 1–4, Fig. 3 (handheld computing device); Ex. 1003 ¶¶ 102–115.

ii. "[a] a physiological sensor device comprising"

The cited evidence supports Petitioner's undisputed contention that Mendelson-799 discloses a physiological sensor device including sensor 10 and pulse oximeter 20. Pet. 46; *see, e.g.*, Ex. 1012, code (57) ("A sensor for use in an optical measurement device."), 9:22–40 (describing sensor 10), 10:16–30 (describing pulse oximeter 20, including sensor 10), Figs. 7–8.

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[5] Whether the preamble is limiting need not be resolved because Petitioner shows sufficiently that the preamble's subject matter is satisfied by the art.

iii. "[b] a plurality of emitters configured to emit light into tissue of a user"

The cited evidence supports Petitioner's undisputed contention that Mendelson-799 discloses a plurality of light emitting elements 12a–c that emit light into a user's tissue. Pet. 46–47; *see, e.g.*, Ex. 1012, 9:22–40 ("The sensor 10 comprises . . . light source 12 composed of three closely spaced light emitting elements (e.g., LEDs or laser sources) 12a, 12b and 12c generating light of three different wavelengths."), Fig. 7.

iv. "[c] at least four detectors, wherein each of the at least four detectors has a corresponding window that allows light to pass through to the detector"

<u>Petitioner's Undisputed Contentions</u>

Petitioner contends that Mendelson-799 discloses twelve photodetectors located within a sensor housing. Pet. 48. Patent Owner does not dispute this contention, and we agree with Petitioner. Mendelson-799 discloses that "sensor 10 comprises . . . an array of discrete detectors (e.g., photodiodes)," including six far detectors 16 and six near detectors 18. *See, e.g.*, Ex. 1012, 9:22–40, Fig. 7.

Petitioner does not contend that Mendelson-799 discloses the claimed windows. Rather, Petitioner contends that Schulz teaches "a sensor featuring 'a thin sheet of opaque material' placed inside the sensor's housing . . . with 'a window in the opaque material provid[ing] an aperture for transmission of optical energy to or from the tissue site,'' wherein the opaque material blocks light and avoids saturation of the sensor's detectors. Pet. 32 (quoting Ex. 1013 ¶ 73). Patent Owner does not dispute this contention, and we agree with Petitioner. Schulz discloses that a "thin sheet of opaque material" can be placed between the optical components of the sensor and

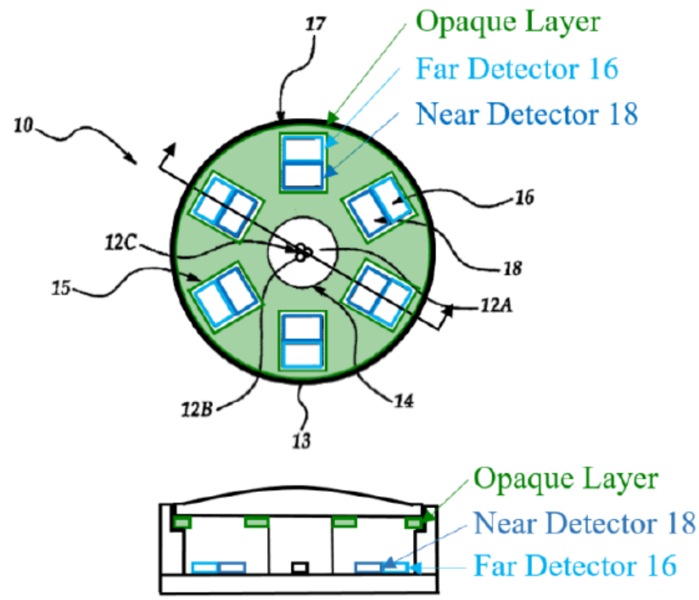
the sensor's housing. Ex. 1013 ¶ 73. Schulz explains that the opaque material includes a window that allows for transmission of optical energy to the detector. *Id.* According to Schulz, the "opaque material blocks light, and the window in the opaque material can be sized as needed to block the proper amount of light from entering the aperture to, for example, avoid saturation of the light detector." *Id.*

Petitioner's Disputed Contentions

Petitioner further contends that a person of ordinary skill in the art would have been motivated "to add a layer of opaque material" to Mendelson-799's sensor, as taught by Schulz, "and to size windows in the opaque material as appropriate to avoid saturation of each of the sensor's detectors." Pet. 33 (citing, e.g., Ex. 1003 ¶¶ 93–101), 49 (citing, e.g., Ex. 1003 ¶¶ 122–131). According to Petitioner, errors are reduced by minimizing the amount of ambient light that reaches the detectors, for example, by decreasing the angle of incidence to the detectors. *Id.* at 33 (citing Ex. 1019, 76, 79–80, 94). Petitioner contends that a person of ordinary skill in the art would have understood that "Schulz's opaque layer limits errors by decreasing the angle of incidence to the photodiode to that enabled by the window included within the layer, and by otherwise preventing ambient light from reaching the photodiode." *Id.* at 34 (citing, e.g., Ex. 1003 ¶¶ 93–97). Petitioner also contends that a skilled artisan would have recognized that, when applying Schulz's teachings to a sensor with multiple detectors, multiple windows would have been employed. *Id.* at 34 (citing, e.g., Ex. 1003 ¶ 98).

To illustrate its proposed modification, Petitioner includes an annotated and modified view of Mendelson-799's Figure 7, as well as an

added sectional view, both of which are reproduced below. Pet. 36; *see also id.* at 49 (similar figures with slightly different annotations); Ex. 1003 ¶100.



Petitioner's modified figure and added sectional view depict the sensor of Mendelson-799 with an added opaque layer (illustrated in green) having windows, as Petitioner contends would have been rendered obvious by Schulz.[6] Pet. 49.

Patent Owner's Arguments

Patent Owner argues that a person of ordinary skill in the art would not have been motivated to modify Mendelson-799 as proposed because adding an opaque layer would *decrease* signal strength, especially for a reflectance pulse oximeter like Mendelson-799, which Patent Owner alleges has a weak signal already. PO Resp. 47–48 (citing, e.g., Ex. 2004 ¶¶ 83–84); PO Sur-reply 23–24. According to Patent Owner, Schulz uses the

[6] Petitioner's annotated figures also include an added opaque wall and an added top cover as discussed *infra* at Sections II.D.5.v and II.D.5.vi.

window in the opaque material only to reduce "desired" light to a "proper" level, i.e., only to reduce the light generated by the emitter that passes through the user's tissue before reaching the detector, but the window in the opaque material does not reduce *ambient* light. PO Resp. 50 ("Schulz uses a separate cover—not the window [in the opaque material]—to block ambient light.") (citing Ex. 1013 ¶ 41); PO Sur-reply 21–23 (citing, e.g., Ex. 2004 ¶¶ 83–88). Thus, according to Patent Owner, use of a windowed opaque material in Mendelson-799's sensor would make its weak signal even weaker by limiting the light from the emitter. PO Sur-reply 23. Patent Owner argues that decreasing signal strength in this way would have been inconsistent with Petitioner's additional modification to add a convex cover to the sensor of Mendelson-799, to *increase* signal strength. PO Resp. 47–48; PO Sur-reply 26; *see infra* § II.D.5.vi.

Moreover, Patent Owner argues that the motivation put forth by Petitioner—to avoid saturation—is not shown to have been a problem for the sensor of Mendelson-799. PO Resp. 47. Patent Owner also argues that there were "easier approaches for addressing saturation of the detectors," such as "adjusting gain or LED brightness." *Id.* at 48.

Patent Owner also argues aspects of Schulz individually. For example, Patent Owner argues that Schulz is directed to an ear sensor, and that there are physiological differences in measurement locations that are not accounted for by Petitioner. PO Resp. 49 (citing, e.g., Ex. 2004 ¶ 85). Additionally, Patent Owner argues that Schulz discloses only a single window, not multiple windows as claimed. *Id.*; PO Sur-reply 26.

Finally, Patent Owner criticizes Petitioner's reliance on additional evidence that does not form part of the asserted ground. *Id.* at 51–52 (citing, e.g., Ex. 1019; Ex. 1023; Ex. 2004 ¶¶ 89–91).

Analysis

We have considered the parties' arguments and cited evidence, and we are persuaded by Petitioner's contentions. As discussed above, Schulz explicitly teaches that its opaque material and window "blocks light" and "avoid[s] saturation of the light detector." Ex. 1013 ¶ 73. Petitioner cites persuasive and well-supported evidence, including the testimony of its declarant, that a person of ordinary skill in the art would have been motivated to add such an arrangement to the sensor of Mendelson-799 to achieve this same disclosed benefit, i.e., to avoid saturation of Mendelson's detectors. *See, e.g.*, Ex. 1003 ¶¶ 95–96. For example, Dr. Kenny's testimony regarding the ability of an opaque material with windows to avoid saturation is supported by Schulz and by the Webster textbook, which discusses the importance of minimizing "light other than the optical signals of interest." *Id.* ¶ 96 (citing Ex. 1019, 76). We are persuaded by Petitioner's contentions and Dr. Kenny's testimony.

We do not agree with Patent Owner's argument that this modification would *decrease* signal strength. PO Resp. 47–48. We discern that Petitioner's proposed modification would not alter the signal of interest, i.e., the optical signal that passes from the emitter, through the user's tissue, and to the photodetectors. Rather, the cited evidence of record supports Petitioner's contention that the proposed modification would have blocked light *other than* that from the signal of interest, i.e., that the modification would have block light *other than* that from the emitter. *See, e.g.*, Ex. 1003

¶ 100 ("Schulz would have motivated one of ordinary skill to modify the sensor . . . to further include an opaque layer that would have *blocked light other than at windows corresponding to the sensor's photodiodes*.") (emphasis added); Ex. 1013 ¶ 73 ("The opaque material blocks light, and the window in the opaque material can be sized as needed to block the proper amount of light from entering the aperture to, for example, avoid saturation of the light detector."); *see also* Pet. Reply 21–22. Thus, we do not agree that the proposed modification would have decreased signal strength.

We have considered Patent Owner's argument that Schulz uses the opaque material to reduce only "desired" light to a "proper" level, i.e., to reduce light from the emitter that passes through the user's tissue, to avoid saturation. PO Resp. 50; PO Sur-reply 22–23 (citing, e.g., Ex. 2004 ¶¶ 83–88). We do not find any support for this argument in Schulz. To the contrary, Schulz explains that "the window in the opaque material can be sized as needed to block the proper amount of light from entering the aperture to, for example, avoid saturation of the light detector." Ex. 1013 ¶ 73. Contrary to Patent Owner's argument, Schulz simply states that its window is sized to control the amount of light *that enters the aperture*; Schulz does not state where that light comes from, or that it only controls against light from the emitter. Patent Owner identifies no basis in Schulz's disclosure to conclude that Schulz's emitter operates at a level that would saturate the detector, absent the addition of an opaque material. *See also* Pet. Reply 25–26. Likewise, we do not find any support for this argument in the cited portions of Dr. Madisetti's declaration. *See, e.g.*, Ex. 2004 ¶ 88 (concluding, without persuasive explanation, that Schulz's window blocks

light only from the emitter, not ambient light); *but see, e.g.*, Ex. 1043, 28:11–18 (agreeing that ambient light is an example of interfering noise).

We also do not agree with Patent Owner's argument that Petitioner has not shown that saturation was a problem for Mendelson-799's sensor. PO Resp. 47. Mendelson-799 need not identify a problem with saturation in order to be improved by the proposed modification. Indeed, Petitioner "does not need to show that there was a known problem with the prior art system." *Unwired Planet, LLC v. Google Inc.*, 841 F.3d 995, 1002–03 (Fed. Cir. 2016); *see also Sci. Plastic Prods., Inc. v. Biotage AB*, 766 F.3d 1355, 1359–61 (Fed. Cir. 2014); *Hologic, Inc. v. Minerva Surgical, Inc.*, 764 F. App'x 873, 880 (Fed. Cir. 2019). As expressly recognized in *KSR*, *any* art-recognized need or problem can provide a reason for combining claim elements. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007). Here, Petitioner provides sufficient evidence to demonstrate that saturation was a known problem (*see, e.g.*, Ex. 1003 ¶ 96; Ex. 1019, 79;[7] Ex. 1047 ¶ 47) and that Schulz provided a readily-applicable technique to solve it (Ex. 1013 ¶ 73). That "easier approaches" may have existed, *see* PO Resp. 48, does not teach away from the approach explicitly taught by Schulz.

We also do not agree with Patent Owner's argument that Schulz and Mendelson-799 are incompatible because they obtain measurements at different locations. Mendelson-799 explains that its sensor type can be used in "multiple convenient locations on the body," and does not exclude use on

[7] It is of no moment that this evidence is not identified as part of the asserted ground. PO Resp. 51–52. This evidence is cited by Dr. Kenny as support for his testimony, consistent with our rules. 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.").

a patient's ear or elsewhere. Ex. 1012, 2:15–21; *contra* PO Resp. 49; *see also* Ex. 1019, 104 ("The idea of using skin reflectance spectrophotometry marked a significant advancement in the noninvasive monitoring of S_aO_2 from virtually any point on the skin surface."). Moreover, the proposed modification does not seek to bodily incorporate the references, one with the other. Rather, Petitioner clearly proposes modifying Mendelson-799 to include an opaque material with windows, as taught by Schulz, but plainly does not propose incorporating any other aspect of Schulz, such as its measurement location. *See* Pet. 47–49; *see also In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973) ("Combining the teachings of references does not involve an ability to combine their specific structures.").

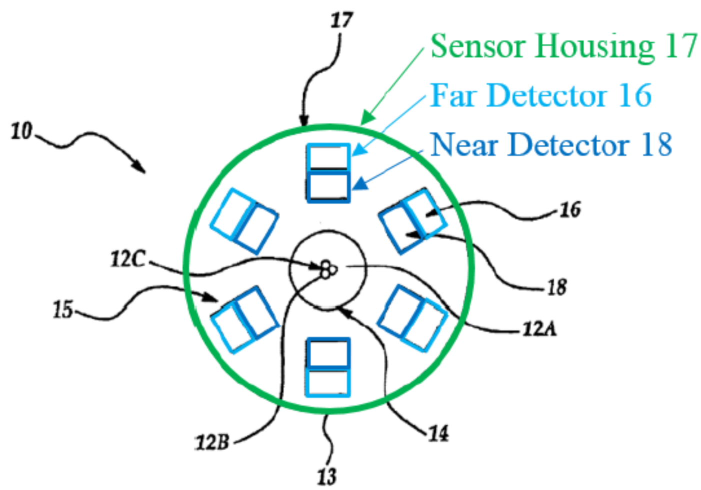
We have considered the remainder of Patent Owner's arguments, but we do not agree with them. For example, it is irrelevant that Schulz teaches only a single window, because Petitioner provides persuasive testimony to show that a skilled artisan would have implemented a window for *each detector* in Mendelson-799's sensor. PO Resp. 49; Ex. 1003 ¶¶ 98–100. It is likewise irrelevant that Schulz discloses an additional "separate cover . . . to block ambient light," because the presence of a separate cover does not change the fact that Schulz explicitly teaches using its windowed opaque material to avoid detector saturation. *See* Ex. 1013 ¶ 73; *contra* PO Resp. 50; PO Sur-reply 21–22.

For the foregoing reasons, we are persuaded by Petitioner's contentions.

v. "[d] a wall that surrounds at least the at least the four detectors"

The cited evidence supports Petitioner's undisputed contentions regarding this limitation. Pet. 50–53. Specifically, Petitioner contends that

Mendelson-799 discloses sensor housing 17 that encircles detectors 16, 18, as shown below in Petitioner's annotated and modified view of Mendelson-799's Figure 7. *Id.* at 50–51; *see, e.g.*, Ex. 1012, 9:23–40 ("All these elements are accommodated in a sensor housing 17."), Fig. 7.



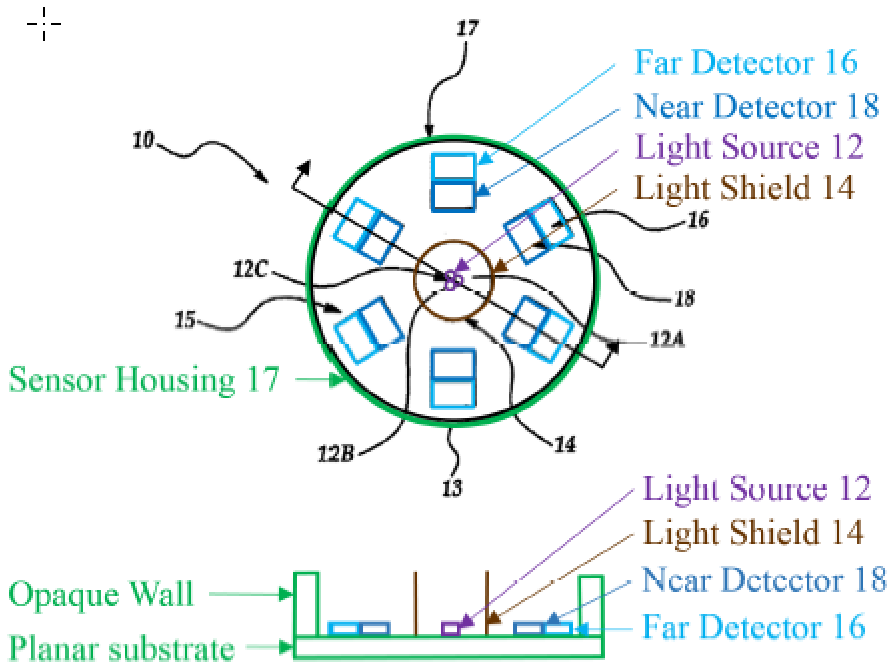
Petitioner's modified figure depicts the sensor of Mendelson-799 with sensor housing 17 identified in green and encircling the detectors.

Petitioner acknowledges that Mendelson-799 does not depict a side view of the sensor and thus, to the extent Mendelson-799 does not explicitly teach that housing 17 includes an opaque wall that surrounds the detectors, a person of ordinary skill in the art would have found it obvious "to connect, to the illustrated portion of sensor housing 17, an opaque wall configured to circumscribe the array of discrete detectors," to shield the detectors from ambient light and to protect from external forces. Pet. 14–15, 24–25, 50–52; *see, e.g.*, Ex. 1003 ¶¶ 63, 69, 82, 134.

Petitioner contends this is consistent with the purpose of Mendelson-799's light shield 14, which prevents the emitters' light from reaching the detectors directly (Pet. 15 (citing Ex. 1012, 9:35–40)), as well as other prior art references cited in Mendelson-799 (*id.* at 15–17 (citing Exs. 1017,

1018)). *See, e.g.*, Ex. 1003 ¶¶ 64–68, 135–139. For example, Petitioner states that Ohsaki discloses that sensor package 5 includes a wall that surrounds light emitting element 6 and light receiving element 7. Pet. 52; *see, e.g.*, Ex. 1009 ¶ 17, Fig. 2; Ex. 1003 ¶¶ 140–141.

To illustrate its proposed modification, Petitioner includes an annotated and modified view of Mendelson-799's Figure 7, as well as an added sectional view, both of which are reproduced below. Pet. 18; *see also id.* at 26 (same), 52 (similar figures with slightly different annotations).



Petitioner's modified and added figures depict the sensor of Mendelson-799 with an added opaque wall (illustrated in green) connected to the planar substrate of housing 17 and encircling the sensor components, as Petitioner contends would have been obvious to a person of ordinary skill in the art. *Id.* at 18, 50–51; Ex. 1003 ¶¶ 82, 142–143.

Patent Owner does not dispute Petitioner's contentions regarding this limitation. *See generally* PO Resp.; PO Sur-reply.

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny, who testifies that such a wall would "shield the detectors from ambient light, and protect the detectors from external forces." Ex. 1003 ¶ 136; *see also* Ex. 1003 ¶¶ 63–71, 82, 132–144.

vi. "[e–g] a cover that operably connects to the wall and that is configured to be located between tissue of the user and the at least four detectors when the physiological sensor device is worn by the user, wherein: the cover comprises a single protruding convex surface, and at least a portion of the cover is sufficiently rigid to cause tissue of the user to conform to at least a portion of a shape of the single protruding convex surface when the physiological sensor device is worn by the user"

<u>Petitioner's Undisputed Contentions</u>

Petitioner contends that Mendelson-799 does not disclose a cover located between the user's tissue and the four detectors, as claimed. Pet. 26–27. Patent Owner does not dispute this contention, and we agree that Mendelson-799 is not shown to include a cover. *See generally* Ex. 1012.

Petitioner relies upon Ohsaki for the recited cover, and contends that:

> Ohsaki discloses a wrist-worn "pulse wave sensor" that includes a light permeable convex cover—"translucent board 8"—that is configured to be located between user tissue and a detector when the sensor is worn, where the cover comprises a single protruding convex surface operable to conform [to] tissue of the user, and where a wall operably connects to a substrate and to the cover.

Pet. 27–28, 53–55 (citing, e.g., Ex. 1009 ¶¶ 15, 17, 25; Ex. 1003 ¶ 86). Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki discloses that sensor 1 is "worn on the back side of the user's wrist" and includes translucent board 8, with a single convex surface formed on the top of the board, to be placed against a user's tissue. Ex. 1009 ¶¶ 16, 17,

Figs. 1–2 (depicting translucent board 8 between tissue and detector). As shown in Ohsaki's Figure 2, the board 8 is operably connected to the walls of sensor package 5 that houses the sensor components, including circuit board 9, light emitting element 6 (e.g., LED), and light receiving element 7. *Id.* ¶ 17 ("The translucent board 8 is . . . attached to the opening of the package 5."), Fig. 2.

Petitioner also contends that the user's tissue conforms to the shape of the convex surface, such that a person of ordinary skill in the art would have understood the convex surface to be "sufficiently rigid." Pet. 55–57. Patent Owner does not dispute this contention, and we agree with Petitioner. As depicted in Ohsaki's Figure 2, the user's tissue 4 is shown to conform to the shape of the protruding convex surface when the sensor is worn by the user. Ex. 1009 ¶ 17 ("The translucent board 8 is a glass board."), Fig. 2; *see, e.g.*, Ex. 1003 ¶ 160 (testifying as to the convex surface's rigidity).

<u>Petitioner's Disputed Contentions</u>

Petitioner further contends that a person of ordinary skill in the art "would have recognized that a light permeable cover with a protruding convex surface," such as that taught by Ohsaki, "would improve adhesion between the sensor and the user's tissue, improve detection efficiency, and protect the elements within sensor housing 17." Pet. 26 (citing, e.g., Ex. 1003 ¶ 84; Ex. 1009 ¶¶ 15, 17, 25), 29–30. Petitioner contends that Ohsaki's convex surface is in intimate contact with the user's tissue, which prevents slippage of the sensor and increases signal strength because "variation of the amount of the reflected light . . . that reaches the light receiving element 7 is suppressed" and "disturbance light from the outside"

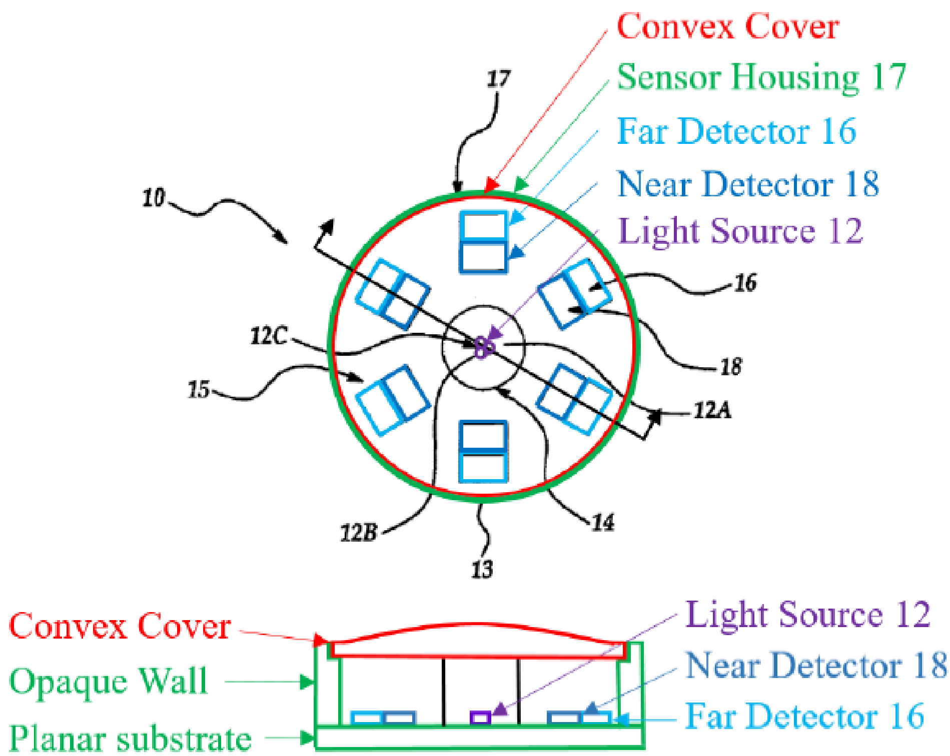
is prevented from penetrating board 8, as compared to a sensor with a flat surface. *Id.* at 28–29 (citing, e.g., Ex. 1003 ¶ 87; quoting Ex. 1009 ¶ 25).

Accordingly, Petitioner contends that, to achieve these identified benefits, a person of ordinary skill in the art "would have added a transparent convex cover to [Mendelson-799's] sensor 10, the cover being located between tissue of the user and the array of detectors 16 and 18 when worn." Pet. 30 (citing, e.g., Ex. 1003 ¶ 91; Ex. 1009 ¶¶ 15, 17, 25). Petitioner also contends that an ordinarily skilled artisan would have "configured the cover to be sufficiently rigid to conform tissue of the user to at least a portion of the cover's surface when worn." *Id.* (citing, e.g., Ex. 1009 ¶ 30). Additionally, Petitioner contends the skilled artisan would have "configured Mendelson-799's circumscribing wall to operably connect" to the sensor's planar substrate and to the convex cover. Pet. 30–31; *see also id.* at 53–57 (citing, e.g., Ex. 1003 ¶ 91).

Petitioner contends these modifications would have been "nothing more than the use of a known technique to improve similar devices in the same way, and combining prior art elements according to known methods to yield predictable results—improved adhesion of the sensor to the user's skin, and improved signal strength," where "the elements of the resulting sensor would each perform functions they had been known to perform prior to the combination—a cover would simply be placed over the components accommodated within Mendelson-799's sensor housing 17, and would perform the same function as taught by Ohsaki." *Id.* at 31–32 (citing, e.g., Ex. 1003 ¶¶ 84–92).

To illustrate its proposed modification, Petitioner includes an annotated and modified view of Mendelson-799's Figure 7, as well as an

added sectional view, both of which are reproduced below. Pet. 31 (citing Ex. 1003 ¶¶ 84–92); *see also id.* at 54 (same).



Petitioner's modified and added figures depict the sensor of Mendelson-799 with an added convex cover (illustrated in red) connected to the wall of Mendelson-799's sensor (illustrated in green, *see supra* § II.D.5.v). Pet. 30–31, 54–55; *see, e.g.*, Ex. 1003 ¶¶ 153–154.

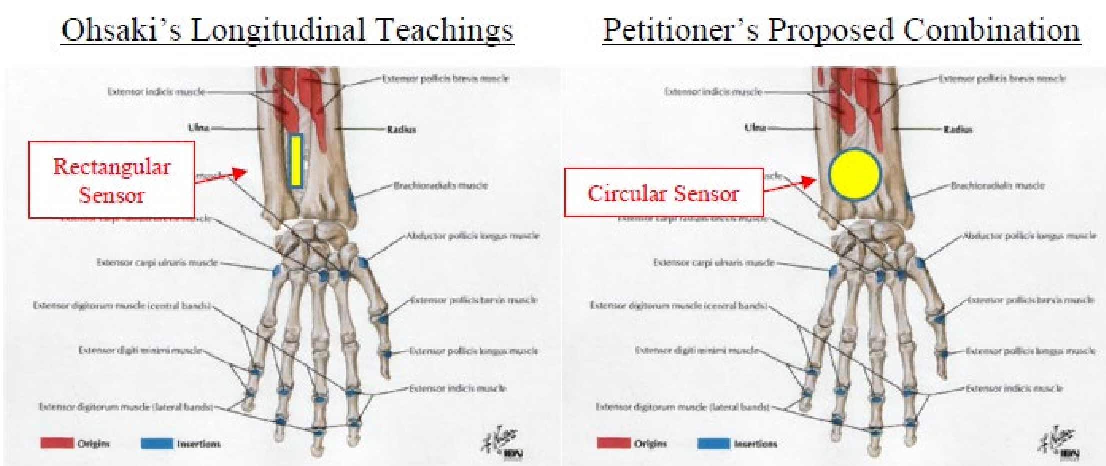
<u>Patent Owner's Arguments</u>

Patent Owner argues that a person of ordinary skill in the art would not have been motivated to modify Mendelson-799's sensor to include Ohsaki's convex cover. PO Resp. 23–47; PO Sur-Reply 2–21.

First, Patent Owner argues that the proposed modification "changes Ohsaki's structure and eliminates the longitudinal shape that gives Ohsaki's translucent board the ability to fit within the user's anatomy and prevent slipping." PO Resp. 23. This argument is premised on Patent Owner's

contention that Ohsaki's convex cover must be rectangular, with the cover's long direction aligned with the length of the user's forearm, to avoid interacting with bones in the wrist and forearm. *Id.* at 24–25 (citing, e.g., Ex. 2004 ¶¶ 51–54; Ex. 1009 ¶¶ 6, 19, 23, 24); *see also* PO Sur-reply 2–10. According to Patent Owner, Ohsaki teaches that "aligning the sensor's longitudinal direction with the circumferential direction of the user's arm undesirably results in 'a tendency [for Ohsaki's sensor] to slip off.'" PO Resp. 25–26 (citing Ex. 1009 ¶ 19), 27–28.

Thus, Patent Owner contends that Petitioner's proposed modification would "chang[e] Ohsaki's rectangular board into a circular shape," which "would eliminate the advantages discussed above" because it "cannot be placed in any longitudinal direction and thus cannot coincide with the longitudinal direction of the user's wrist." *Id.* at 26 (citing Ex. 2004 ¶¶ 55–56). Patent Owner presents annotated Figures depicting what it contends is Ohsaki's disclosed sensor placement as compared to that of the proposed modification, reproduced below.



Patent Owner's annotated Figure on the left depicts a rectangular sensor placed between a user's radius and ulna, while Patent Owner's annotated

Figure on the right depicts a circular sensor placed across a user's radius and ulna. Based on these annotations, Patent Owner argues that the proposed "circular shape would press on the user's arm in all directions and thus cannot avoid the undesirable interaction with the user's bone structure," such that a skilled artisan "would have understood such a change would eliminate Ohsaki's benefit of preventing slipping." *Id.* at 27–28 (citing, e.g., Ex. 2004 ¶¶ 55–58).

Second, Patent Owner argues that Ohsaki requires its sensor be placed on the back of the user's wrist to achieve any benefits, but that such a location would have been unsuitable for Mendelson-799's sensor, and would result in weak sensor signals. PO Resp. 32. Relying on other publications by the named inventor on Mendelson-799, Patent Owner alleges that sensor signals were difficult or impossible to discern from the wrist, even with considerable pressure. *Id.* (citing Ex. 2003, 3–4); *see also id.* at 33–34 (citing Ex. 2015, 3, 4; Ex. 2014, 1, 99). Patent Owner contends that Dr. Kenny admitted that signals from the wrist are weaker and noisier than from other locations. *Id.* at 33 (citing Ex. 2008, 249:10–16, 255:12–21); *see also id.* at 34–37 (citing Ex. 2017, 2; Ex. 2018, 4; Ex. 2010, 44, 71; Ex. 2016, 2, 3).

Third, Patent Owner argues that a person of ordinary skill in the art would not have placed Ohsaki's convex cover over Mendelson-799's peripheral detectors because the convex cover would condense light toward the center and away from the detectors, which would decrease signal strength. PO Resp. 38–43 (citing, e.g., Ex. 2004 ¶¶ 71–76). Patent Owner also contends that Petitioner and Dr. Kenny admit as much, fail to account for the impact of the proposed modification on light collection, and fail to

propose a specific three-dimensional structure to embody the proposed modification. *Id.* at 38–43 (citing, e.g., Ex. 2020, 69–70; Ex. 2006, 204:14–20; Ex. 2008, 36:19–37:1, 57:19–58:16, 63:5–64:8, 170:12–171:1, 173:8–15). Patent Owner relies on Figure 14B of the ’554 patent, which Patent Owner contends supports its position. *Id.* at 39–40 (citing Ex. 1001, 36:3–6, 36:13–15).

Fourth, Patent Owner argues that Ohsaki’s rectangular cover creates air gaps at its peripheral edges, as shown in Ohsaki’s Figure 1, which Mendelson-799 cautions against as potentially causing “specular reflection.” PO Resp. 43–44 (citing, e.g., Ex. 1012, 2:58–64). Accordingly, Patent Owner argues that a person of ordinary skill in the art “would not have modified Mendelson[-]799’s structure to add Ohsaki’s air gaps.” *Id.* at 44 (citing Ex. 2004 ¶¶ 77–78).

Fifth, Patent Owner argues that “a convex cover is just one of many different alternatives for protecting the components of a sensor” including, e.g., resin or encapsulation. PO Resp. 45–46. Concerning possible alternatives, Patent Owner contends that a person of ordinary skill in the art “would have understood that a flat cover would provide better protection than a convex surface because—as Petitioner’s cited art teaches—a flat cover would be less prone to scratches.” *Id.* at 46–47 (citing Ex. 1008 ¶ 106).

<u>Petitioner’s Reply</u>

Concerning Patent Owner’s first and second arguments, Petitioner responds that Ohsaki does not disclose the shape of its protrusion, other than its convexity as shown in Figures 1 and 2, nor does Ohsaki require a rectangular shape or placement on the back of the wrist in order to achieve

the disclosed benefits. Pet. Reply 7–12 (citing, e.g., Ex. 1047 ¶¶ 17–30). Moreover, Petitioner asserts that "even if Ohsaki's translucent board 8 were somehow understood to be rectangular, obviousness does not require 'bodily incorporation' of features from one reference into another"; rather, a person of ordinary skill in the art "would have been fully capable of attaching a light permeable protruding convex cover to Me[nd]elson-799's housing to obtain the benefits attributed to such a cover by Ohsaki." *Id.* at 10 (citing, e.g., Ex. 1047 ¶ 23). Similarly, regarding the location of the sensor, Petitioner asserts,

> [E]ven if a [person of ordinary skill in the art] would have somehow misunderstood Ohsaki's sensor as limited to placement on the backside of the wrist, and even if the difficulty that [Patent Owner] alleges with respect to obtaining pulse oximetry measurements from that location were true, that would have further motivated the [person of ordinary skill in the art] to implement a light permeable convex cover in Mendelson-799's sensor, to improve detection efficiency.

Id. at 11 (citing, e.g., Ex. 1047 ¶ 26).

Concerning Patent Owner's third argument, Petitioner responds that adding a convex cover to Mendelson-799's sensor would not decrease signal strength but, instead, "would improve Mendelson-799's signal-to-noise ratio by causing more light backscattered from tissue to strike Mendelson-799's detectors than would have absent the cover" because such a cover improves light concentration across the entire lens and does not direct it only towards the center. *Id.* at 13–17 (citing, e.g., Ex. 1047 ¶¶ 31–45).

Petitioner dismisses Patent Owner's reliance on Figure 14B of the '554 patent because it "is not an accurate representation of light that has been reflected from a tissue measurement site. For example, the light rays

(1420) shown in FIG. 14B are collimated (i.e., travelling paths parallel to one another), and each light ray's path is perpendicular to the detecting surface." Pet. Reply 13–14 (citing, e.g., Ex. 1047 ¶¶ 32–34). Moreover, Petitioner argues that, even when collimated, light will focus at the center "only if the light beam happens to be perfectly aligned with the axis of symmetry of the lens" and, when entering at any other angle, will focus at a different point. *Id.* at 15 (citing, e.g., Ex. 1047 ¶ 35).

According to Petitioner, Patent Owner's and Dr. Madisetti's position regarding convergence toward the center does not apply to diffuse light, which reaches the detectors from various random angles and directions after having been reflected by tissue. *Id.* at 15–16 (citing, e.g., Ex. 1047 ¶ 36). As a result, Petitioner contends Ohsaki's cover would have provided a refracting effect such that light rays that would have missed the detectors absent a cover are instead directed to that area as they pass through the cover. *Id.* at 16–17 (citing Ex. 1047 ¶¶ 37–39). Petitioner thus contends that "overall, more of the partially reflected, transmitted, absorbed, and ultimately back scattered light strikes the detectors than otherwise would have absent the cover." *Id.* at 17 (citing Ex. 1047 ¶¶ 32–40).

Concerning Patent Owner's fourth argument, Petitioner responds that a skilled artisan would have known to avoid air gaps in the proposed combination. *Id.* at 18 (citing, e.g., Ex. 1047 ¶¶ 41–43).

Concerning Patent Owner's fifth argument, Petitioner responds that even if a flat surface might be less prone to scratching, that possible disadvantage would have been weighed against the "multiple advantages of a convex cover," and would not negate a motivation to combine. *Id.* at 19 (citing, e.g., Ex. 1047 ¶ 45).

Patent Owner's Sur-reply

Concerning Patent Owner's first and second arguments, Patent Owner reiterates its position that Ohsaki's purported benefits attach only to a sensor with a rectangular convex surface that is located on the back of the wrist, and that "even small changes in sensor orientation or measurement location result in slippage." PO Sur-reply 3–14, 7.

Concerning Patent Owner's third argument, Patent Owner argues that Dr. Kenny and Petitioner have not overcome their admissions that a convex lens directs light toward the center. *Id.* at 15–16 (citing, e.g., Ex. 2004 ¶¶ 72–76).

Patent Owner also asserts that Petitioner mischaracterizes Patent Owner's position, which is not that a convex cover focuses "***all*** light" to a single point at the center of the sensor. *Id.* at 16. Patent Owner instead states that, "[l]ight entering the convex surface from all angles would, on average, result in more light directed towards the center and less light at the periphery—as compared to a flat surface—and therefore less light at the peripherally located detectors." *Id.* at 17 (citing Ex. 2004 ¶¶ 71–75).

Finally, Patent Owner argues that Petitioner's Reply arguments are overly complex and instead a person of ordinary skill in the art "would have understood and applied the straightforward understanding that a convex surface condenses light toward the center." *Id.* at 18–19.

Concerning Patent Owner's fourth argument, Patent Owner argues that "Petitioner does not dispute that . . . air gaps would dissuade a [person of ordinary skill in the art] from modifying Mendelson[-]799." *Id.* at 19.

Concerning Patent Owner's fifth argument, Patent Owner argues that Petitioner does not dispute Patent Owner's position that a flat cover would be less prone to scratches and offers "***no*** plausible advantages for its asserted combination." *Id.* at 22. Moreover, Patent Owner argues that "the risk of scratches is not merely a disadvantage—it directly undermines Petitioner's motivation to add a convex cover to 'protect the elements within the sensor housing.'" *Id.*

Analysis

As noted above, Petitioner provides three rationales to support its contention that a person of ordinary skill in the art would have provided "a light permeable cover with a protruding convex surface," such as that taught by Ohsaki, to Mendelson-799's sensor: (1) to "improve adhesion between the sensor and the user's tissue," (2) to "improve detection efficiency," and (3) to "protect the elements within sensor housing 17." Pet. 26 (citing, e.g., Ex. 1003 ¶ 84; Ex. 1009 ¶¶ 15, 17, 25), 29–30. We conclude all three rationales are supported by the evidence, as follows.

Rationales 1 and 2

The evidence of record persuades us that a person of ordinary skill in the art would have been motivated to add a convex cover, such as that taught by Ohsaki, to improve adhesion between the sensor and the user's skin, which would have increased the signal strength of the sensor. Ohsaki teaches as much:

> [T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby *it is prevented that the detecting element 2 slips off* the detecting position of the user's wrist 4. If the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the

> movement of the user's wrist 4 as shown in Fig. 4B. However, in the case that the translucent board 8 has a convex surface like the present embodiment, the *variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8*. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25 (emphasis added); *see also id.* ¶ 27 ("stably fixed").

We credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated by such teachings to apply a cover with a convex surface to Mendelson-799 to improve that similar device in the same way and to yield predictable results, i.e., to resist movement of the sensor on the user's wrist. *See, e.g.*, Ex. 1003 ¶ 87 ("[T]his contact between the convex surface and the user's skin is said to prevent slippage, which increases the strength of the signals obtainable by Ohsaki's sensor."). We also credit Dr. Kenny's testimony that, in light of these teachings, a person of ordinary skill in the art would have made such a modification to improve the pulse sensor's ability to emit light into, and detect light reflected from, the user's wrist, to generate an improved pulse signal. Ex. 1003 ¶¶ 88–89, 149–150; Ex. 1047 ¶ 12.

Indeed, Ohsaki expressly compares the performance of a wrist-worn pulse wave sensor depending on whether translucent board 8 is convex or flat, and concludes the convex surface results in improved performance over the flat surface, especially when the user is moving. Ex. 1009, Figs. 4A–4B, ¶¶ 15, 25 (stating that with "a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4," and with "a

convex surface like the present embodiment, the variation of the amount of the reflected light" collected by the sensor "is suppressed"). Ohsaki also states that, with a convex surface, "[i]t is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8." *Id.* ¶ 25.

We also credit Dr. Kenny's testimony that the proposed modification would have been within the level of ordinary skill in the art. For example, Dr. Kenny testifies:

> The above-described modification would require only routine knowledge of sensor design and assembly, which were well within the skill of one of ordinary skill prior to the Critical Date. Indeed, the modification would have amounted to nothing more than the use of a known technique to improve similar devices in the same way, and combining prior art elements according to known methods to yield predictable results—improved adhesion of the sensor to the user's skin, and improved signal strength. Furthermore, the elements of the resulting sensor would each perform functions they had been known to perform prior to the combination—Ohsaki's translucent board 8 would simply be placed over the components accommodated within Mendelson '799's sensor housing 17, and would perform the same function as taught by Ohsaki.

Ex. 1003 ¶ 92; *see also id.* ¶¶ 88–92, 154. In light of Ohsaki's express disclosure of the benefits of a convex cover, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to modify Mendelson-799 as proposed, and would have had a reasonable expectation of success in doing so.

We next address Patent Owner's first through fourth arguments, each of which implicates Petitioner's first and second asserted rationales of improved adhesion and detection efficiency.

Patent Owner's first argument is premised on the notion that Ohsaki's benefits only can be realized with a rectangular convex surface, because such a shape is required to avoid interacting with bones on the back of the user's forearm. PO Resp. 23–28. We disagree. Ohsaki does not disclose the shape of its convex cover, much less require it be rectangular. In fact, Ohsaki is silent as to the shape of the convex surface. Ohsaki discloses that sensor 1 includes detecting element 2, which includes package 5 within which the sensor components are located. *Id.* ¶ 17. Ohsaki's convex surface is located on board 8, which is "attached to the opening of the package 5." *Id.* Ohsaki provides no further discussion regarding the shape of board 8 or its convex surface.

We disagree with Patent Owner's suggestion that the shape of the convex surface can be inferred to be rectangular from Ohsaki's Figures 1 and 2. PO Resp. 17–18. Ohsaki does not indicate that these figures are drawn to scale, or reflect precise dimensions or shapes of the convex surface. *See, e.g.*, Ex. 1009 ¶ 13 ("schematic diagram"); *see also* Pet. Reply 9; *Hockerson-Halberstadt, Inc. v. Avia Group Int'l*, 222 F.3d 951, 956 (Fed. Cir. 2000) ("[I]t is well established that patent drawings do not define the precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue.").

To be clear, Ohsaki describes the shape of *detecting element 2* as rectangular: "[T]he length of the detecting element from the right side to the left side in FIG. 2 is longer than the length from the upper side to the lower side." *Id.* ¶ 19. Ohsaki also describes that detecting element 2 is aligned longitudinally with the user's forearm: "[I]t is desirable that the detecting element 2 is arranged so that its longitudinal direction agrees with the

longitudinal direction of the user's arm," to avoid slipping off. *Id.*; *see also id.* ¶ 9 ("The light emitting element and the light receiving element are arranged in the longitudinal direction of the user's arm.").

In light of this disclosed rectangular shape of detecting element 2, it is certainly possible that Ohsaki's convex surface may be similarly shaped. But, it may not be. Contrary to Patent Owner's argument, Ohsaki neither describes nor requires detecting element 2 to have the same shape as the convex surface of board 8. *Accord* Pet. Reply. 7–8 (noting also that Ohsaki's board 8 "is not coextensive with the entire tissue-facing side of detecting element 2"). We have considered the cited testimony of both Dr. Kenny and Dr. Madisetti on this point. Ex. 1047 ¶¶ 10–12, 12 n.2, 17–23; Ex. 2004 ¶¶ 38–41 (relying on Ohsaki's Figures 1–2 to support his opinion that the convex surface is rectangular). Dr. Madisetti's reliance on the dimensions of Ohsaki's figures is unpersuasive. *Hockerson-Halberstadt*, 222 F.3d at 956. We credit Dr. Kenny's testimony that Ohsaki does not describe its convex surface as rectangular, because this testimony is most consistent with Ohsaki's disclosure.

Further, Patent Owner suggests that the convex surface *must be* rectangular, in order to avoid interacting with bones in the user's forearm. PO Resp. 28; PO Sur-Reply 9 ("[A] POSITA would have understood Ohsaki's convex board must also have a longitudinal shape oriented up-and-down the watch-side of the user's wrist/forearm."). Although Ohsaki recognizes that interaction with these bones can cause slippage problems, *see* Ex. 1009 ¶¶ 6, 19, we do not agree that the *only way* to avoid these bones is by aligning a rectangular cover with the longitudinal direction of the user's forearm. For example, in the annotated Figures provided by Patent

Owner, *see* PO Resp. 27–28, we discern that the circular sensor that purports to depict the proposed modification would *also* avoid the bones in the forearm if it were slightly smaller. Patent Owner provides no persuasive explanation to justify the dimensions it provides in this annotated figure, or to demonstrate that such a large sensor would have been required. Indeed, we discern that it would have been within the level of skill of an ordinary artisan to appropriately size a modified sensor to avoid these well-known anatomical obstacles. "A person of ordinary skill is also a person of ordinary creativity, not an automaton." *KSR*, 550 U.S. at 421. After all, an artisan must be presumed to know something about the art apart from what the references disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962).

Finally, we do not agree with Patent Owner's position that Ohsaki's advantages apply only to rectangular convex surfaces. As discussed, Patent Owner has not shown that Ohsaki's convex surface is rectangular at all. Moreover, even if Ohsaki's convex surface is rectangular, when discussing the benefits associated with a convex cover, Ohsaki does not limit those benefits to a cover of any particular shape. Instead, Ohsaki explains that "detecting element 2 is arranged on the user's wrist 4 so that the convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby it is prevented that the detecting element 2 slips off the detecting position of the user's wrist 4." Ex. 1009 ¶ 25; Ex. 1047 ¶ 10. Thus, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Mendelson-799's circular-shaped sensor, to improve adhesion as taught by Ohsaki. *See, e.g.*, Pet. 26–28. Nothing in Ohsaki's disclosure

limits such a benefit to a specific shape of the convex surface. Ex. 1047 ¶¶ 11–12.

Moreover, Ohsaki contrasts its convex surface with a flat surface and notes that,

> in the case that the translucent board 8 has a convex surface . . . the variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25; Ex. 1047 ¶ 11. Thus, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Mendelson-799's sensor, to improve signal strength, as taught by Ohsaki. *See, e.g.*, Pet. 26–28. Again, nothing in Ohsaki's disclosure limits such a benefit to the shape of the convex surface. Ex. 1047 ¶¶ 11–12.

Accordingly, we do not agree that Ohsaki's disclosed advantages attach only to a rectangular convex surface, or would have been inapplicable to the proposed combination of Mendelson-799 and Ohsaki.[8]

We have considered Patent Owner's second argument, that Ohsaki's benefits are realized only when the sensor and convex surface are placed on

[8] Patent Owner also argues that, to the extent contended by Petitioner, it would not have been obvious to place a rectangular cover on top of Mendelson-799's sensor. PO Resp. 29–31. We do not understand Petitioner to have made any such contention and, accordingly, do not address this argument. *See, e.g.*, Pet. 31, 54 (depicting circular convex surface over circular sensor).

the back of the user's wrist, which is an unsuitable location for Mendelson-799's sensor. PO Resp. 32–38. We do not agree. As an initial matter, Petitioner does not propose bodily incorporating the references; Petitioner simply proposes adding a convex cover to Mendelson-799's sensor, without discussing where Mendelson-799's sensor is used. *See, e.g.*, Pet. 30. In other words, Petitioner's proposed modification does not dictate any particular placement. Moreover, Mendelson-799 states that its sensor "allows for measuring SaO_2 from multiple convenient locations on the body (e.g. the head, torso, or upper limbs)." Ex. 1012, 2:17–19; *see also* Ex. 1019, 104 ("The idea of using skin reflectance spectrophotometry marked a significant advancement in the noninvasive monitoring of S_aO_2 from virtually any point on the skin surface."). Thus, we do not agree that Mendelson-799 discourages or disparages use on the back of the wrist.

Notwithstanding the foregoing, and assuming for sake of argument that Patent Owner is correct that a person of ordinary skill in the art would have expected a weaker signal from Mendelson-799's sensor if placed on the wrist, *see* PO Resp. 32, that alone does not nullify the proposed combination. "[A] given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine." *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) (citation omitted). Indeed, we discern that, if Mendelson-799's sensor was placed at a location that results in decreased signal quality, a person of ordinary skill in the art would have been further motivated to act to improve signal quality, e.g., by employing Ohsaki's convex surface. *See, e.g.*, Ex. 1047 ¶¶ 27–30; Ex. 1009 ("[I]n the case that the translucent board 8 has a convex surface like the present embodiment, the variation of the amount of

the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.").

We have considered Patent Owner's third argument that a convex cover would condense light away from Mendelson-799's peripheral detectors, which Patent Owner alleges would decrease signal strength. PO Resp. 38–43. We disagree. There appears to be no dispute that when emitted light that passes through user tissue, the light is diffused and scattered as it travels. *See, e.g.*, Pet. Reply 13–17; Tr. 27:18–28:3 (Petitioner's counsel agreeing that "the incoming light from a detection standpoint is going to be coming from all sorts of different directions because of the randomness caused by the back scattering"), 65:23–66:13 (Patent Owner's counsel agreeing that light does not simply enter tissue and come back out "like it came out on a mirror"); Ex. 1041, 35:19–37:18 (Patent Owner's declarant describing light scattering as it travels through tissue, e.g., reflecting off blood, tissue, or other material); Ex. 1043, 28:2–10 (Patent Owner's declarant agreeing that reflecting light can be a signal for the '554 patent's sensor), 61:20–62:4 (explaining that "a light in this context, light emitted from the LEDs is diffused through the skin in that particular context, whatever that is."). The light thus travels at random angles and directions, and no longer travels in a collimated and perpendicular manner.

Dr. Kenny testifies that Mendelson-799 and Ohsaki "detect light that has been 'partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector." Ex. 1047 ¶ 37. Dr. Kenny further opines that, "the POSITA would have understood

that Mendelson-799's sensor, which includes multiple photodiodes placed symmetrically with respect to a central light source, offers the advantage of *enabling a large fraction of light randomly backscattered from tissue to be detected within the circular active detection area surrounding that source*," thus increasing the light-gathering ability of Mendelson-799's sensor. *Id.* ¶ 38 (emphasis added); *see also id.* ¶ 39 ("Ohsaki's cover provides a refracting effect, such that light rays that otherwise would have missed the detection area are instead directed toward that area as they pass through the interface provided by the cover.").

By contrast Dr. Madisetti testifies that "a convex surface condenses light away from the periphery and towards the sensor's center." Ex. 2004 ¶ 74. We have considered this testimony; however, Dr. Madisetti's opinions largely are premised upon the behavior of collimated and perpendicular light as depicted in Figure 14B of the challenged patent. *See id.* Dr. Madisetti does not explain how light would behave when approaching the sensor from various angles, as it would after being reflected by tissue. *Id.* ¶¶ 72–76. In other words, even if Patent Owner is correct that the '554 patent's Figure 14B depicts light condensing toward the center, this is not dispositive to the proposed modification, because light passing through a user's tissue is scattered and random, and is not collimated and perpendicular as shown in Figure 14B. Ex. 1001, Fig. 14B.

Patent Owner and Dr. Madisetti argue that "Petitioner and Dr. Kenny both previously admitted that a convex cover condenses light towards the center of the sensor and away from the periphery in a different petition filed against a related patent," i.e., in IPR2020-01520. PO Resp. 38–39; Ex. 2004 ¶¶ 72–73 (citing Ex. 2019, 45; Ex. 2020 ¶¶ 118–120). The cited portions of

the Petition and Dr. Kenny's declaration from IPR2020-01520 discuss a decrease in the "mean path length" of a ray of light when it travels through a convex lens rather than through a flat surface. *See, e.g.*, Ex. 2020 ¶¶ 118–120. We do not agree that this discussion is inconsistent with Dr. Kenny's testimony here that, where light is reflected to the detectors at various random angles and directions, more light will reach Mendelson-799's symmetrically disposed detectors when travelling through the convex surface than would be reached without such a surface, because light that might have otherwise missed the detectors now will be captured. Ex. 1047 ¶¶ 37–40. We do not discern that the convergence of a single ray of light toward the center, as discussed in IPR2020-01520, speaks to the aggregate effect on *all* light that travels through the convex surface. Patent Owner suggests that this prior discussion means that all light is always directed toward the center regardless of where or how the light approaches the convex surface, however, we do not understand Dr. Kenny's testimony to support such a position. PO Resp. 38–39.

In its Sur-reply, Patent Owner argues that it "never argued that ***all*** light focuses at the center." PO Sur-reply 15–16. Be that as it may, neither Patent Owner nor Dr. Madisetti sufficiently address the diffuse nature of the light at issue here, which reflects from user tissue and scatters. Patent Owner attempts to do so in its Sur-reply, stating that "light entering the convex surface from all angles would, on average, result in more light directed towards the center and less light at the periphery—as compared to a flat surface—and therefore less light at the peripherally located detectors." *Id.* at 17. However, as support, Patent Owner identifies only the same portions of Dr. Madisetti's declaration discussed above, which fail to

address diffuse or scattered light. Ex. 2004 ¶¶ 71–75. Accordingly, considering all evidence of record, we credit the testimony of Dr. Kenny.[9]

With respect to Patent Owner's fourth argument, we do not agree that a person of ordinary skill in the art would have been discouraged from modifying Mendelson-799 as proposed, due to the potential for air gaps to form at the peripheral edges of the convex surface. PO Resp. 43–45. Patent Owner misstates the proposed modification. Petitioner does not propose "modif[ying] Mendelson[-]799's structure to add Ohsaki's air gaps." *Contra* PO Resp. 44. Petitioner proposes modifying Mendelson-799 only to include a cover with a convex surface; Petitioner does not propose including any air gaps that may be present in Ohsaki. *See, e.g.*, Pet. 53. Moreover, even if Ohsaki's Figure 1 depicts small air gaps adjacent the convex surface, Ohsaki nonetheless discloses that the convex surface is in "intimate contact" with the user's skin. Ex. 1009 ¶ 25; *see also Hockerson-Halberstadt*, 222 F.3d at 956. In view of such a teaching, we agree with Petitioner that it would have been within the skill of a person of ordinary skill in the art, who "is also a person of ordinary creativity, not an automaton," to minimize any such air gap that may be present when including a cover with a convex surface in Mendelson-799's sensor. Indeed, a purpose of Petitioner's proposed modification is to increase signal strength. *See, e.g.*, Pet. 27. We discern that it would have been within the capability of an ordinarily skilled

[9] Moreover, we disagree with Patent Owner's argument that Petitioner's Reply arguments are overly complex and instead a person of ordinary skill in the art "would have understood and applied the straightforward understanding that a convex surface condenses light toward the center." PO Sur-reply 18–19. As noted above, this "straightforward understanding" lacks sufficient support, in the context of diffuse light.

artisan to eliminate any air gap that would have decreased signal strength or quality. Ex. 1047 ¶ 43.

Rationale 3

Petitioner further contends that a person of ordinary skill in the art "would have recognized that a light permeable cover with a protruding convex surface," such as that taught by Ohsaki, would "protect the elements within sensor housing 17" of Mendelson-799. Pet. 26. We are persuaded that adding a convex cover, such as that taught by Ohsaki, would protect the sensor's internal components. Mendelson-799 is not shown to include a cover over its emitters 12a–c or detectors 16, 18. *See, e.g.*, Ex. 1012, Fig. 7. By contrast, Ohsaki discloses that translucent board 8 with its convex surface covers its emitter and detector. As such, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to add a transparent convex cover to Mendelson-799 to "provide additional protection to the elements accommodated within sensor housing 17." Ex. 1003 ¶ 150; *see also* Ex. 1008 ¶ 15 (noting that a cover "protect[s] the LED or PD").

We disagree with Patent Owner's fifth argument that a person of ordinary skill in the art would not have modified Mendelson-799 as proposed because a convex cover would be prone to scratches and because other alternatives existed. PO Resp. 45–47. Patent Owner's counsel did not dispute, during the oral hearing, that a convex cover would indeed serve to protect the internal sensor components in Mendelson-799, as Petitioner proposes. Tr. 64:6–65:5 (but noting that a flat cover would also protect, and would be less prone to scratches). That a convex cover may be more prone to scratches than a flat cover is one of numerous tradeoffs that a person of

ordinary skill in the art would consider, in determining whether the benefits of increased adhesion, signal strength, and protection outweigh the potential for a scratched cover. *Medichem*, 437 F.3d at 1165. The record does not support that the possibility of scratches alone would have dissuaded a person of ordinary skill in the art from the proposed modification, to achieve the benefits identified by Petitioner.

For the foregoing reasons, we are persuaded by Petitioner's contentions.

vii. "[h] a handheld computing device in wireless communication with the physiological sensor device, wherein the handheld computing device comprises"

Petitioner's Undisputed Contentions

Petitioner relies upon the teachings of Mendelson-799, Ohsaki, and Schulz, as discussed above, in further combination with Mendelson-2006 for the remainder of the claim limitations. Specifically, Petitioner contends that although Mendelson-799 does not explicitly disclose wireless communication from its sensor to a handheld computing device, its sensor is "for use in an optical measurement device" as part of "a method for non-invasive measurement of a blood parameter." Pet. 37, 43, 57. Patent Owner does not dispute this contention, and we agree with Petitioner. *See, e.g.*, Ex. 1012, code (57) ("A sensor for use in an optical measurement device and a method for non-invasive measurement of a blood parameter.").

Petitioner also contends that Mendelson-2006 discloses a body-worn pulse oximetry system including a sensor module, a receiver module, and a PDA. Pet. 40, 59. Petitioner contends that data processed by the receiver module is transmitted to the PDA and identifies several advantages of

wireless communication noted in Mendelson-2006, including more effective medical care. Pet. 59–60. Patent Owner does not dispute this contention, and we agree with Petitioner. *See, e.g.* Ex. 1010, 1–2 (describing system), 3 ("The stream of data received from the wearable unit is distributed to various locations on the PDA's graphical display."), 4 (explaining that wireless communication results in "more effective medical care"); Fig. 1 (sensor attached to skin), Fig. 3 (PDA).

Petitioner's Disputed Contentions

Petitioner further contends a person of ordinary skill in the art would have found it obvious to enable the sensor of the combination of Mendelson-799, Ohsaki, and Schulz to communicate wirelessly with a handheld computing device such as the PDA of Mendelson-2006, to transfer sensor data and provide more effective care. Pet. 39, 42–43, 57, 60–61; *see, e.g.*, Ex. 1003 ¶¶ 104, 109, 165, 171–175.

Patent Owner's Arguments

Patent Owner presents several arguments directed to Mendelson-2006, including that Mendelson-2006 discloses a single detector (PO Resp. 52), and that Mendelson-2006's sensor is used on the forehead (*id.* at 53). Patent Owner argues that Mendelson-2006 thus confirms that a person of ordinary skill in the art would not have combined Mendelson-799 with Ohsaki or Schulz due to signal strength issues raised by various locations where a sensor might be attached to the user's body. *Id.* at 53–55.

Analysis

We are persuaded that Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony

of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 102–109, 162–176. For example, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to implement Mendelson-799 as part of a physiological measurement system including a handheld communication device in wireless communication, in order to enable transfer of information and improve medical care. *Id.* ¶¶ 170–171.

Moreover, we disagree with Patent Owner's arguments. First, we are persuaded by Petitioner's contentions regarding Mendelson-799, Ohsaki, and Schulz, for the reasons discussed above, and we do not discern that the teachings of Mendelson-2006 undercut those contentions in any manner. Second, Petitioner relies on Mendelson-2006 for teachings regarding wireless communications with a handheld device. Pet. 57–69. Patent Owner's arguments do not pertain to the modification actually proposed and, as such, are misplaced.

viii. "[i] one or more processors configured to wirelessly receive one or more signals from the physiological sensor device, the one or more signals responsive to at least a physiological parameter of the user"

The cited evidence supports Petitioner's contention that Mendelson-2006 describes wirelessly transmitting vital physiological information acquired from the sensor to the PDA, which receives it. Pet. 62–63; *see, e.g.*, Ex. 1010, 1, 2 ("The information acquired by the Sensor Module is transmitted wirelessly via an RF link over a short range to a body-worn Receiver Module. The data processed by the Receiver Module can be transmitted wirelessly to a PDA."), 3 (explaining that the PDA "has sufficient computational resources for the intended application" and "can also serve to temporarily store vital medical information received from the

wearable unit"), Fig. 3 (displaying SpO_2 and HR data); Ex. 1003 ¶¶ 179–180.

Petitioner further contends that, in light of these teachings, a person of ordinary skill in the art "would have found it obvious to configure a processor of the PDA to wirelessly receive signals from the physiological sensor device, the signals being responsive to physiological parameters of the user." Pet. 63; *see, e.g.*, Ex. 1003 ¶ 181

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny. Ex. 1003 ¶¶ 177–182. Patent Owner does not present any argument against this limitation, apart from the arguments already addressed in Section II.D.5.vii.

ix. "[j]–[l] a touch-screen display configured to provide a user interface, wherein: the user interface is configured to display indicia responsive to measurements of the physiological parameter, and an orientation of the user interface is configurable responsive to a user input"

The cited evidence supports Petitioner's contention that Mendelson-2006 describes a PDA with a touchscreen display configured to display indicia responsive to measurements of, e.g., SpO_2 and HR. Pet. 64–65; *see, e.g.*, Ex. 1010, 3 ("The use of a PDA . . . also provides a low-cost touch screen interface.").

Petitioner acknowledges that "Mendelson-2006 does not explicitly state that an orientation of the GUI provided by the PDA is configurable responsive to a user input." Pet. 66. However, Petitioner contends that a person of ordinary skill in the art would have understood that "the LabVIEW software that was used 'to control all interactions between the PDA and the wearable unit via [t]he graphical user interface' included the option to

configure an orientation of a user interface," e.g. by setting the report orientation to portrait or landscape view. *Id.* (alteration in original); *see, e.g.*, Ex. 1003 ¶¶ 187–188; Ex. 1027, 186 ("Set the report orientation—portrait or landscape.").

Petitioner further contends that, in light of these teachings, a person of ordinary skill in the art "would have found it obvious to make an orientation of the PDA's user interface configurable responsive to a user input, for the sake of user convenience." Pet. 67; *see, e.g.*, Ex. 1003 ¶¶ 189–190.

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny, who testifies that the proposed modification would have allowed for easy activation of various functions. *See, e.g.*, Ex. 1003 ¶¶ 183–191. Patent Owner does not present any argument against this limitation, apart from the arguments already addressed in Section II.D.5.vii.

x. "[m] a storage device configured to at least temporarily store at least the measurements of the physiological parameter"

The cited evidence supports Petitioner's contention that Mendelson-2006 teaches that the PDA is configured to store vital medical information received from the wearable pulse oximeter, and that an ordinarily skilled artisan "would have understood that the vital medical information would have included measurements of the physiological parameters obtained by the physiological sensor device (e.g., SpO_2 and HR)." Pet. 68; Ex. 1010, 3 ("The PDA can also serve to temporarily store vital medical information received from the wearable unit."); Ex. 1003 ¶ 194.

Petitioner further contends that, in light of these teachings, a person of ordinary skill in the art "would have found it obvious to configure a storage

device of the PDA to at least temporarily store measurements of physiological parameters (e.g., SpO_2 and HR)." Pet. 68; *see, e.g.*, Ex. 1003 ¶ 193.

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 192–194. Patent Owner does not present any argument against this limitation, apart from the arguments already addressed in Section II.D.5.vii.

xi. Reasonable Expectation of Success

Patent Owner argues that Petitioner has failed to demonstrate a reasonable expectation of success because Dr. Kenny did not perform a design analysis to create a functional sensor. PO Resp. 55. We disagree. As discussed in detail above, each of Petitioner's proposed modifications to Mendelson-799—whether to include an opaque material with windows, as taught by Schulz; or to include a cover with a convex surface, as taught by Ohsaki; or to communicate with a handheld computing device, as taught by Mendelson-2006—is rooted in explicit teachings of the prior art, and is supported by persuasive declarant testimony.

We credit Dr. Kenny's testimony that, for each proposed modification, the combined prior art teachings would have been applied as known, to achieve predictable results. *See, e.g.*, Ex. 1003 ¶¶ 92 (applying Ohsaki's teachings would have been "nothing more than the use of a known technique to improve similar devices in the same way, and combining prior art elements according to known methods to yield predictable results—improved adhesion of the sensor to the user's skin, and improved signal strength"), 101 (applying Schulz's teachings would have been "nothing

more than the use of a known technique to improve similar devices in the same way, and combining prior art elements according to known methods to yield predictable results," i.e. to "avoid saturation"), 173 ("applying Mendelson[-]2006's teachings . . . would have led to predictable results without altering or hindering the functions performed by that device. In fact, one of ordinary skill would have been motivated to implement the well-known technique of wirelessly transmitting data . . . to a handheld computing device"). For similar reasons discussed above with respect to each proposed modification, we conclude that that a skilled artisan would have had a reasonable expectation of success. *See supra* § II.D.5.iv, vi, vii–x; *see also* Ex. 1003 ¶¶ 81–195.

xii.Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

6. Independent Claim 20

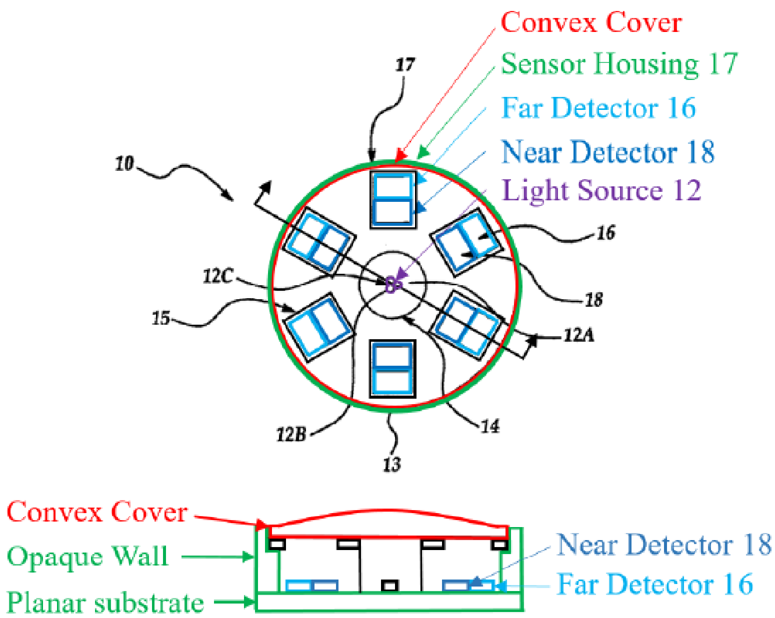
Independent claim 20 consists of limitations that are substantially similar to elements [a]–[h] of claim 1. *Compare* Ex. 1001, 44:51–45:21, *with id.* at 46:31–52 (reciting that the "convex surface," as opposed to "the cover," is "sufficiently rigid"; omitting details of the "handheld computing device"). In asserting that claim 20 also would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006, Petitioner refers to the same arguments presented as to claim 1. *See* Pet. 79–82. Patent Owner relies on the same arguments discussed above regarding claim 1. PO Resp. 12–63.

For the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 20 would have been obvious over the cited combination of references. *See supra* § II.D.5.

7. Dependent Claims 6 and 25

Dependent claim 6 ultimately depends from independent claim 1 and further recites, "the wall surrounds at least the at least four detectors on the first surface, the wall operably connects to the substrate on one side of the wall, and the wall operably connects to the cover on an opposing side of the wall." Ex. 1001, 45:40–47. Likewise, dependent claim 25 ultimately depends from independent claim 20 and further recites "a substrate having a first surface, wherein the at least four detectors are arranged on the first surface, and wherein the wall surrounds at least the at least four detectors on the first surface, wherein: the wall operably connects to the substrate on one side of the wall, and the wall operably connects to the cover on an opposing side of the wall." *Id.* at 47:15–48:6.

Petitioner contends that the sensor rendered obvious by the combined teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006 "would have included a wall surrounding the photodiodes included in far detector 16 and near detector 18, the wall being operably connected on one side to the planar substrate on which the detectors are arranged, and on an opposing side to a cover," as shown in Petitioner's annotated and modified view of Mendelson-799's Figure 7, as well as an added sectional view, both of which are reproduced below. Pet. 76–77 (citing, e.g., Pet. § IV.B.6.1[d]; Ex. 1003 ¶¶ 132–144, 211–212); *see also id.* at 89–90 (similar discussion regarding claim 25) (citing, e.g., Ex. 1003 ¶¶ 257–29).



Petitioner's annotated and modified figures depict the sensor of Mendelson-799 with an added opaque wall illustrated in green and encircling the sensor components, and operably connected to the convex cover (illustrated in red) on the top and operably connected to the planar substrate of sensor housing 17 (illustrated in green) on the bottom.

Patent Owner argues that "Petitioner provides no independent analysis" for these claims and instead refers back to analyses of claims 1 and 20. PO Resp. 57. Patent Owner also argues that, in the annotated figures, Petitioner includes features not shown in the cited references, e.g., "a cover . . . spanning the entire space above the substrate" and a wall with "notches for the convex cover." *Id.* at 58. Patent Owner argues that "Petitioner cannot satisfy" the claims "by making unexplained changes to the cited art." *Id.* at 59. Moreover, Patent Owner argues that neither Ohsaki nor Mendelson-799 disclose a wall as claimed. *Id.*

As shown in the modified figures above, the wall of the combined sensor surrounds the sensor components and is operably connected to the

convex cover on the top and is operably connected to the planar substrate on the bottom, as claimed. Moreover, as discussed above regarding claim 1, Petitioner's proposed modifications to Mendelson-799 are *not* premised upon bodily incorporating Ohsaki's cover directly with Mendelson-799's sensor. *See In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973) ("Combining the teachings of references does not involve an ability to combine their specific structures."). To the contrary, Petitioner proposes incorporating Ohsaki's *teaching* of a cover with a convex surface, not the precise cover and structure disclosed by Ohsaki. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981) ("[T]he test is what the combined teachings of those references would have suggested to those of ordinary skill in the art."). If Ohsaki's teaching is implemented in a manner that varies from the precise implementation of such a cover in Ohsaki, e.g., with a larger span or with notches, this is not a material deviation from Ohsaki's express teachings of using a cover with a convex surface to achieve specific benefits, e.g., improved adhesion and signal strength. Ex. 1009 ¶ 25; *see supra* § II.D.5.vi; *see Lear Siegler, Inc. v. Aeroquip Corp.*, 733 F.2d 881, 889 (Fed. Cir. 1984) (explaining that a person of ordinary skill is not "compelled to adopt every single aspect of [a reference] without the exercise of independent judgment").

Accordingly, for the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 6 and 25 would have been obvious over the cited combination of references.

8. Dependent Claim 28

Dependent claim 28 ultimately depends from independent claim 20 and further recites "the single protruding convex surface protrudes a height greater than 2 millimeters and less than 3 millimeters." Ex. 1001, 48:16–18.

Petitioner reiterates that the sensor rendered obvious by the combined teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006 would have included a cover with a single protruding convex surface, *see supra* § II.D.5.vi, and further contends that a person of ordinary skill in the art "would have found it obvious that a device designed to fit on a user's wrist would be on the order of millimeters," consistent with Ohsaki's disclosure that the device is in "intimate contact" with the user's skin. Pet. 94–95 (citing, e.g., Ex. 1003 ¶ 269). Petitioner also contends that an ordinarily skilled artisan would have taken user comfort into account when establishing the dimensions of the device's convex cover. *Id.* at 96. With these considerations in mind, Petitioner contends that, "in order to provide a comfortable cover featuring a protruding convex surface that prevents slippage, the surface should protrude a height greater than 2 millimeters and less than 3 millimeters," because "there would have been a finite range of possible protruding heights, and it would have been obvious to select a protruding height that would have been comfortable to the user." *Id.* (citing, e.g., Ex. 1003 ¶¶ 267–271).

Patent Owner argues that none of the cited references disclose the claimed height range and that Petitioner relies on hindsight reconstruction. PO Resp. 60–62 (citing, e.g., Ex. 2004 ¶¶ 104–105). Patent Owner also characterizes Dr. Kenny's testimony as conclusory and unsupported. *Id.* at 62.

Petitioner is correct that, "[w]hen there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product . . . of ordinary skill and common sense." *KSR*, 550 U.S. at 398. Petitioner has shown sufficiently that only a finite number of solutions existed with respect to the height of a convex protrusion on a tissue-facing sensor, which would have met the art-recognized goals of both (1) intimate contact between the sensor's surface and the user and (2) user comfort. *See, e.g.*, Ex. 1009 ¶¶ 6, 25. Bearing in mind these considerations, we credit Dr. Kenny's testimony that it would have been obvious, "in order to provide a comfortable cover featuring a protruding convex surface that prevents slippage, [that] the surface should protrude a height greater than 2 millimeters and less than 3 millimeters." Ex. 1003 ¶ 270.

We have considered Patent Owner's argument, and Dr. Madisetti's cited testimony. However, it is not dispositive that none of Mendelson-799, Ohsaki, Schulz, or Mendelson-2006 teach the claimed range. PO Resp. 60; Ex. 2004 ¶¶ 105–107. Petitioner relies upon the knowledge, ability, and creativity of a person of ordinary skill in the art, not the teachings of a specific reference. Notably, Dr. Madisetti does not dispute Dr. Kenny's position that there were a finite number of options available for the height of the convex surface. Ex. 2004 ¶¶ 104–107. Therefore, we do not agree that Petitioner's contentions are rooted in impermissible hindsight. *See, e.g.*, *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971) ("Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was

within the level of ordinary skill at the time the claimed invention was made and does not include knowledge gleaned only from applicant's disclosure, such a reconstruction is proper.").

Accordingly, for the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 28 would have been obvious over the cited combination of references.

9. Dependent Claims 2–5, 7, 21–24, 26, and 27

Petitioner also contends that claims 2–5, 7, 21–24, 26, and 27 would have been obvious based on the same combination of prior art addressed above. These challenged claims all depend directly or indirectly from independent claim 1 or 20. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 69–79, 82–96. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 196–210, 213–215, 237–256, 260–266.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claims 1 and 20. PO Resp. 56 ("The Petition fails to establish that independent claims 1 and 20 are obvious over the cited references of Ground 1 and therefore fails to establish obviousness of any of the challenged dependent claims."); *see supra* § II.D.5.

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–5, 7, 21–24, 26, and 27 would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, and

Mendelson-2006, for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny.

10. Conclusion

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 1–7 and 20–28 would have been obvious over the cited combination of references.

III. CONCLUSION

In summary:[10]

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–7, 20–28	103	Mendelson-799, Ohsaki, Schulz, and Mendelson-2006	1–7, 20–28	
Overall Outcome			1–7, 20–28	

[10] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–7 and 20–28 of the ’554 patent have been shown to be unpatentable;

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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U.S. DEPARTMENT OF COMMERCE
UNITED STATES PATENT AND TRADEMARK OFFICE

May 23, 2022

THIS IS TO CERTIFY that the attached document is a list of the papers that comprise the record before the Patent Trial and Appeal Board (PTAB) for the *Inter Partes* Review proceeding identified below.

APPLE INC.,

Petitioner,

v.

MASIMO CORPORATION,

Patent Owner.

Case No.: IPR2020-01539
United States Patent No.: 10,588,554 B2

By authority of the
DIRECTOR OF THE UNITED STATES
PATENT AND TRADEMARK OFFICE

/s/ Mekbib Solomon
Certifying Officer

PROSECUTION HISTORY FOR *INTER PARTES* REVIEW NO.: IPR2020-01539

DATE	DESCRIPTION
09/02/2020	Petition for *Inter Partes* Review
09/02/2020	Petitioner's Power of Attorney
09/02/2020	Petitioner's Notice Ranking Petitions and Explaining Material Differences
09/17/2020	Notice of Filing Date Accorded
09/21/2020	Patent Owner's Mandatory Notices
11/04/2020	Petitioner's Updated Exhibit List
12/17/2020	Patent Owner's Notice of Waiver of Preliminary Response
03/02/2021	Decision - Institution of *Inter Partes* Review Proceeding
03/02/2021	Scheduling Order
03/16/2021	Patent Owner's Objections to Admissibility of Petitioner's Evidence Submitted Before Trial Institution
04/08/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
04/14/2021	Stipulation Modifying Due Dates
04/16/2021	Patent Owner's Motion for *Pro Hac Vice* Admission – Jeremiah Helm
04/16/2021	Patent Owner's Motion for *Pro Hac Vice* Admission – William Zimmerman
04/16/2021	Patent Owner's Updated Exhibit List
04/20/2021	Decision Granting Patent Owner's Motions for *Pro Hac Vice* Admission
04/20/2021	Patent Owner's Amended Notice of Deposition - Thomas W. Kenny
04/21/2021	Patent Owner's Updated Mandatory Notice
04/21/2021	Patent Owner's Supplemental Power of Attorney – W. Zimmerman and J. Helm
04/22/2021	Petitioner's Motion to Submit Supplemental Information
05/06/2021	Order Granting Petitioner's Motion to Submit Supplemental Information
05/14/2021	Petitioner's Submission of Supplemental Information
06/08/2021	Patent Owner's Response
06/17/2021	Petitioner's Objections to Evidence
07/19/2021	Petitioner's Notice of Deposition - Vijay K. Madisetti
09/03/2021	Petitioner's Reply to Patent Owner's Response
09/09/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
09/10/2021	Patent Owner's Objections to Evidence
09/13/2021	Petitioner's Updated Mandatory Notice
10/15/2021	Patent Owner's Sur-Reply to Reply
10/22/2021	Petitioner's Objections to Evidence
10/22/2021	Petitioner's Request for Oral Hearing
10/22/2021	Patent Owner's Oral Argument Request
10/28/2021	Patent Owner's Supplemental Mandatory Notices
11/01/2021	Order Setting Oral Argument
11/22/2021	Petitioner's Identification of Testimony
12/03/2021	Patent Owner's Demonstratives for Trial Hearing
12/03/2021	Petitioner's Updated Exhibit List

DATE	DESCRIPTION
01/06/2022	Oral Hearing Transcript
02/23/2022	Final Written Decision
04/12/2022	Notice of Appeal

Trials@uspto.gov
571-272-7822

Paper 41
Entered: February 23, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

IPR2020-01539
Patent 10,588,554 B2

Before GEORGE R. HOSKINS, ROBERT L. KINDER, and AMANDA F. WIEKER, *Administrative Patent Judges.*

WIEKER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

Apple Inc. ("Petitioner") filed a Petition requesting an *inter partes* review of claims 1–28 ("challenged claims") of U.S. Patent No. 10,588,554 B2 (Ex. 1001, "the '554 patent"). Paper 3 ("Pet."). Masimo Corporation ("Patent Owner") waived filing a Preliminary Response. Paper 7. We instituted an *inter partes* review of all challenged claims 1–28 on all asserted grounds of unpatentability, pursuant to 35 U.S.C. § 314. Paper 8 ("Inst. Dec.").

After institution, Patent Owner filed a Response (Paper 23, "PO Resp.") to the Petition, Petitioner filed a Reply (Paper 26, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 30, "PO Sur-reply").[1] An oral hearing was held on December 7, 2021, and a transcript of the hearing is included in the record. Paper 40 ("Tr.").

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, Petitioner has met its burden of showing, by a preponderance of the evidence, that challenged claims 1–12 and 14–28 of the '554 patent are unpatentable. However, Petitioner has not met its burden of showing, by a preponderance of the evidence, that challenged claim 13 is unpatentable.

[1] After the Sur-reply was filed, we authorized Petitioner to file an Identification of Testimony. Paper 36.

B. Related Proceedings

The parties identify the following matters related to the ’554 patent:

Masimo Corporation v. Apple Inc., Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

Apple Inc. v. Masimo Corporation, IPR2020-01538 (PTAB Sept. 2, 2020) (also challenging claims 1–7 and 20–28 of the ’554 patent);

Apple Inc. v. Masimo Corporation, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2); and

Apple Inc. v. Masimo Corporation, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2).

Pet. 3–4; Paper 5, 1–3.

Patent Owner further identifies the following pending patent applications, among other issued and abandoned applications, that claim priority to, or share a priority claim with, the ’554 patent:

U.S. Patent Application No. 16/834,538;

U.S. Patent Application No. 16/449,143; and

U.S. Patent Application No. 16/805,605.

Paper 5, 1–2.

C. The ’554 Patent

The ’554 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on March 17, 2020, from U.S. Patent Application No. 16/544,713, filed August 19, 2019. Ex. 1001, codes (21), (22), (45), (54). The ’554 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The ’554 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:38–40. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:29–35, 64–65. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:45–48.

Figure 1 of the '554 patent is reproduced below.

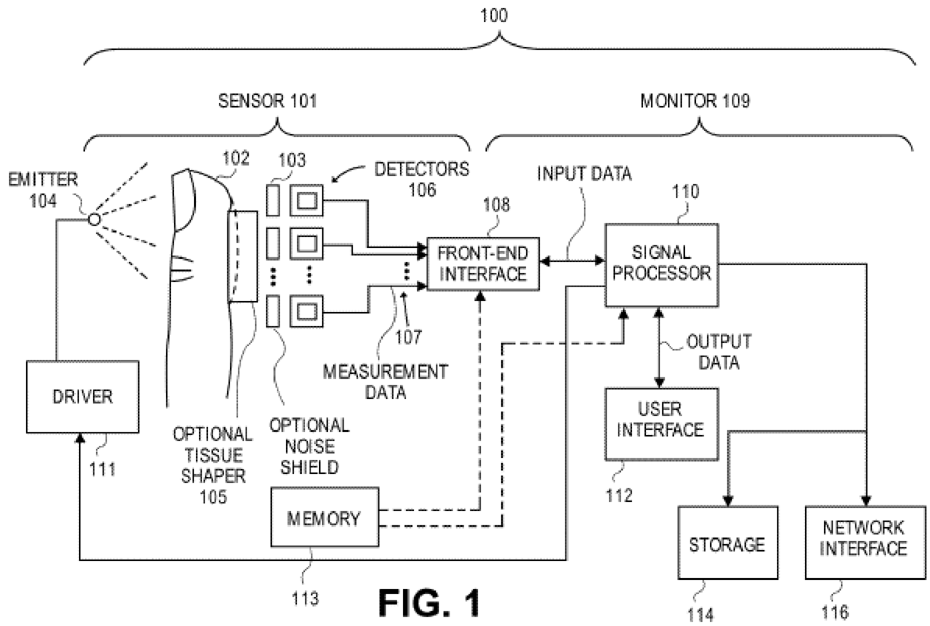

FIG. 1

Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:47–58. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* at 11:59–63. Emitters 104 emit light that is attenuated or reflected by the patient's tissue at measurement site 102. *Id.* at 14:3–7. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light, detectors 106 output detector signals 107 to monitor 109 through front-end interface 108. *Id.* at 14:7–10, 26–32. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 11:2–14.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:16–18. "[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals received from the detectors." *Id.* at 15:21–24. User interface 112 presents

the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:46–56. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 15:60–16:11.

The ’554 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate detector portions of sensor devices.

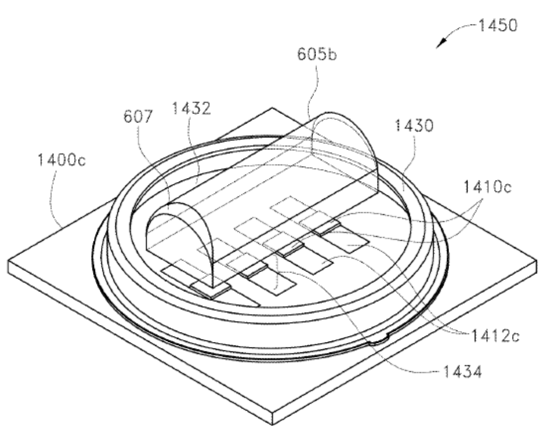

FIG. 14D

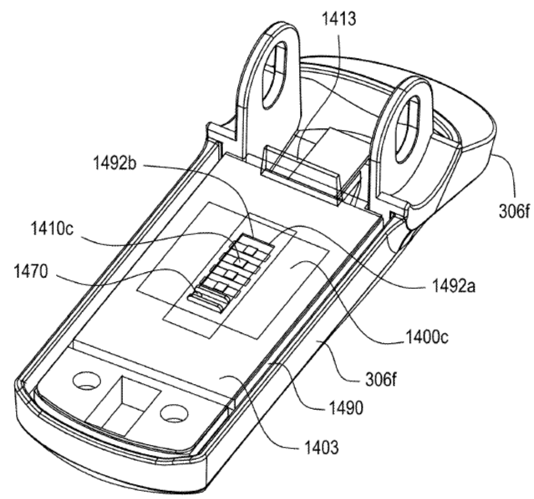

FIG. 14F

Figure 14D illustrates portions of a detector submount and Figure 14F illustrates portions of a detector shell. *Id.* at 6:44–47. As shown in Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 35:36–39, 36:30–37. Figure 14F illustrates a detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 37:9–17. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* Alternatively, cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:47–48.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.

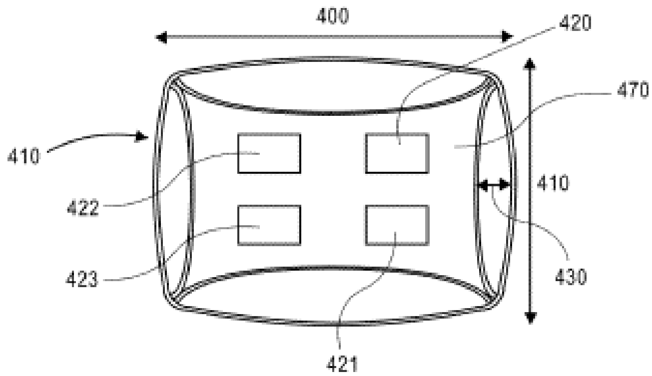

FIG. 4A

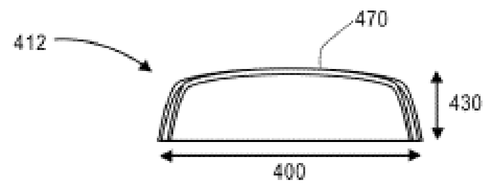

FIG. 4B

Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:18–24. "[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site." *Id.* "For example, . . . measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site." *Id.* at 23:39–43. The measurement site contact area may include windows 420–423 that "mimic or approximately mimic a configuration of, or even house, a plurality of detectors." *Id.* at 23:49–63.

D. Illustrative Claim

Of the challenged claims, claims 1 and 20 are independent. Claim 1 is illustrative and is reproduced below.

1. A physiological measurement system comprising:

[a] a physiological sensor device comprising:

[b] a plurality of emitters configured to emit light into tissue of a user;

[c] at least four detectors, wherein each of the at least four detectors has a corresponding window that allows light to pass through to the detector;

[d] a wall that surrounds at least the at least four detectors; and

[e] a cover that operably connects to the wall and that is configured to be located between tissue of the user and the at least four detectors when the physiological sensor device is worn by the user, wherein:

[f] the cover comprises a single protruding convex surface, and

[g] at least a portion of the cover is sufficiently rigid to cause tissue of the user to conform to at least a portion of a shape of the single protruding convex surface when the physiological sensor device is worn by the user; and

[h] a handheld computing device in wireless communication with the physiological sensor device, wherein the handheld computing device comprises:

[i] one or more processors configured to wirelessly receive one or more signals from the physiological sensor device, the one or more signals responsive to at least a physiological parameter of the user;

[j] a touch-screen display configured to provide a user interface,

wherein:

[k] the user interface is configured to display indicia responsive to measurements of the physiological parameter, and

[l] an orientation of the user interface is configurable responsive to a user input; and

[m] a storage device configured to at least temporarily store at least the measurements of the physiological parameter.

Ex. 1001, 44:51–45:21 (bracketed identifiers a–m added). Independent claim 20 includes limitations substantially similar to limitations [a]–[h] of claim 1. *Id.* at 46:31–52.

E. Applied References

Petitioner relies upon the following references:

> Aizawa, U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002 (Ex. 1006, "Aizawa");
>
> Inokawa et al., Japanese Patent Application Publication No. 2006-296564 A, filed April 18, 2005, published November 2, 2006 (Ex. 1007, "Inokawa");[2]
>
> Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1009, "Ohsaki");
>
> Y. Mendelson et al., "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," Proceedings of the 28th IEEE EMBS Annual International Conference, 912–915 (2006) (Ex. 1010, "Mendelson-2006"); and
>
> Bergey, U.S. Patent No. 3,789,601, filed July 15, 1971, issued February 5, 1974 (Ex. 1016, "Bergey").

Pet. 12.

Petitioner also submits, *inter alia*, a Declaration of Dr. Thomas W. Kenny, Ph.D. (Ex. 1003) and a Second Declaration of Dr. Kenny (Ex. 1047). Patent Owner submits, *inter alia*, the Declaration of Dr. Vijay K. Madisetti (Ex. 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madisetti, including from this proceeding and others. Exs. 1041–1043, 2006–2009, 2027.

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[2] Petitioner relies on a certified English translation of Inokawa (Ex. 1008). Ex. 1008, 24. In this Decision, we also refer to the translation.

F. Asserted Grounds of Unpatentability

We instituted an *inter partes* review based on the following grounds. Inst. Dec. 9, 32.

Claims Challenged	35 U.S.C. §	References/Basis
1–7, 20–28	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006
8–19	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006, Bergey

II. DISCUSSION

A. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2019). Petitioner submits that no claim term requires express construction. Pet. 11. Patent Owner submits that claim terms should be given their ordinary and customary meaning, consistent with the Specification. PO Resp. 9.

We agree that no claim terms require express construction. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

B. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103(a) if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406

(2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness.[3] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must support its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

Petitioner identifies the appropriate level of skill in the art as that possessed by a person having "a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software

[3] Patent Owner has not presented objective evidence of non-obviousness.

technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information." Pet. 10 (citing Ex. 1003 ¶¶ 1–18, 20–21). "Additional education in a relevant field or industry experience may compensate for one of the other aspects of the . . . characteristics stated above." *Id.* at 11.

Patent Owner makes several observations regarding Petitioner's identified level of skill in the art but, "[f]or this proceeding, [Patent Owner] nonetheless applies Petitioner's asserted level of skill." PO Resp. 10.

We adopt Petitioner's assessment as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

D. Obviousness over the Combined Teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006

Petitioner contends that claims 1–7 and 20–28 of the '554 patent would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006. Pet. 41–87; *see also* Pet. Reply 1–36. Patent Owner disagrees. PO Resp. 11–67; *see also* PO Sur-reply 1–27.

Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of the evidence that claims 1–7 and 20–28 are unpatentable.

1. Overview of Aizawa (Ex. 1006)

Aizawa is a U.S. patent application publication titled "Pulse Wave Sensor and Pulse Rate Detector," and discloses a pulse wave sensor that detects light output from a light emitting diode and reflected from a patient's artery. Ex. 1006, codes (54), (57).

Figure 1(a) of Aizawa is reproduced below.

FIG. 1 (a)

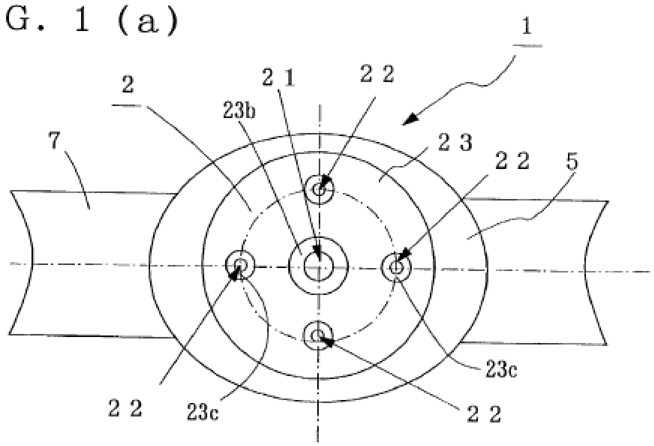

Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode ("LED") 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses that, "to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased." *Id.* ¶ 32, Fig. 4(a). "The same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector 22." *Id.* ¶ 33.

Figure 1(b) of Aizawa is reproduced below.

FIG. 1 (b)

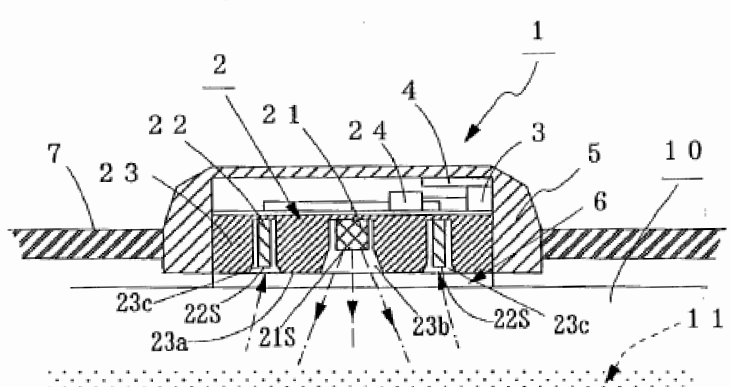

Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* ¶ 23. Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an "unshown display." *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.*

Aizawa discloses that LED 21 and photodetectors 22 "are stored in cavities 23b and 23c formed in the detection face 23a" of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a "is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a." *Id.* ¶ 24. Aizawa discloses that "a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting face 21s of the light emitting diode 21 faces down (on the wrist 10 side)." *Id.* ¶ 26. Furthermore, "the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10. Thereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶¶ 26, 34.

2. *Overview of Inokawa (Ex. 1007)*

Inokawa is a Japanese published patent application titled "Optical Vital Sensor, Base Device, Vital Sign Information Gathering System, and Sensor Communication Method," and discloses a pulse sensor device. Ex. 1008 code (57), ¶ 6.

Figure 1 of Inokawa is reproduced below.

(FIG. 1)

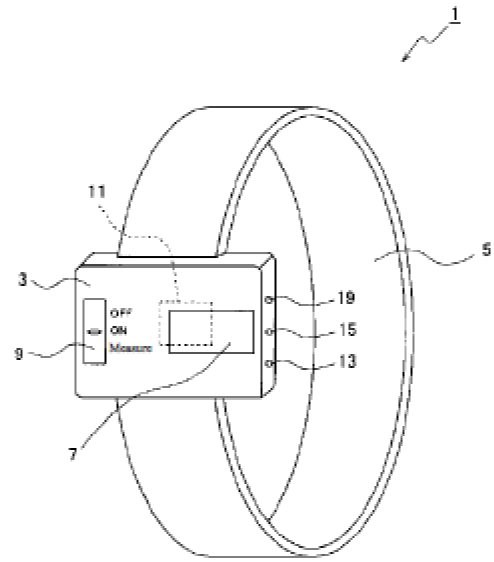

Figure 1 illustrates a schematic view of a pulse sensor. *Id.* ¶ 56. Pulse sensor 1 includes box-shaped sensor unit 3 and flexible annular wristband 5. *Id.* ¶ 57. Sensor unit 3 includes a top surface with display 7 and control switch 9, and a rear surface (sensor-side) with optical device component 11 for optically sensing a user's pulse. *Id.*

Figure 2 of Inokawa is reproduced below.

(FIG. 2)

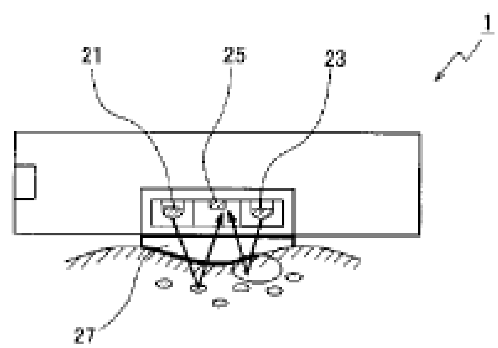

Figure 2 illustrates a schematic view of the rear surface of the pulse sensor. *Id.* ¶ 58. The rear-side (sensor-side) of pulse sensor 1 includes a pair of

light-emitting elements, i.e., green LED 21 and infrared LED 23, as well as photodiode 25 and lens 27. *Id.* In various embodiments, Inokawa discloses that the sensor-side lens is convex. *See id.* ¶¶ 99, 107. Green LED 21 is used to sense "the pulse from the light reflected off of the body (i.e.[,] change in the amount of hemoglobin in the capillary artery)," and infrared LED 23 is used to sense body motion from the change in reflected light. *Id.* ¶ 59. The pulse sensor stores this information in memory. *Id.* ¶ 68. To read and store information, the pulse sensor includes a CPU that "performs the processing to sense pulse, body motion, etc. from the signal . . . and temporarily stores the analysis data in the memory." *Id.* ¶ 69.

Figure 3 of Inokawa is reproduced below.

(FIG. 3)

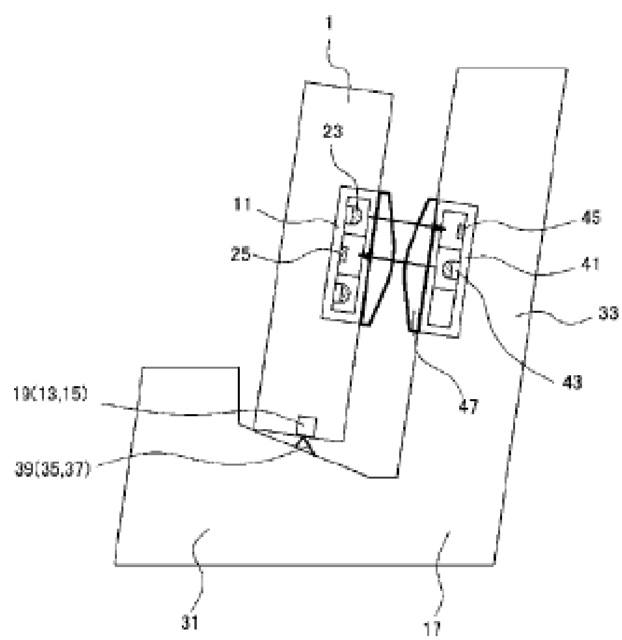

Figure 3 illustrates a schematic view of a pulse sensor mounted to a base device. *Id.* ¶ 60. Pulse sensor 1 is depicted as mounted to base device 17, which "is a charger with communication functionality." *Id.* When so mounted, sensor optical device component 11 and base optical device

component 41 face each other in close proximity. *Id.* ¶ 66. In this position, pulse sensor 1 can output information to the base device through the coupled optical device components. *Id.* ¶ 67. Specifically, the pulse sensor CPU performs the controls necessary to transmit pulse information using infrared LED 23 to photodetector 45 of base device 17. *Id.* ¶¶ 67, 70, 76. In an alternative embodiment, additional sensor LEDs and base photodetectors can be used to efficiently transmit data and improve accuracy. *Id.* ¶ 111.

3. Overview of Ohsaki (Ex. 1009)

Ohsaki is a U.S. patent application publication titled "Wristwatch-type Human Pulse Wave Sensor Attached on Back Side of User's Wrist," and discloses an optical sensor for detecting a pulse wave of a human body. Ex. 1009, code (54), ¶ 3. Figure 1 of Ohsaki is reproduced below.

FIG. 1

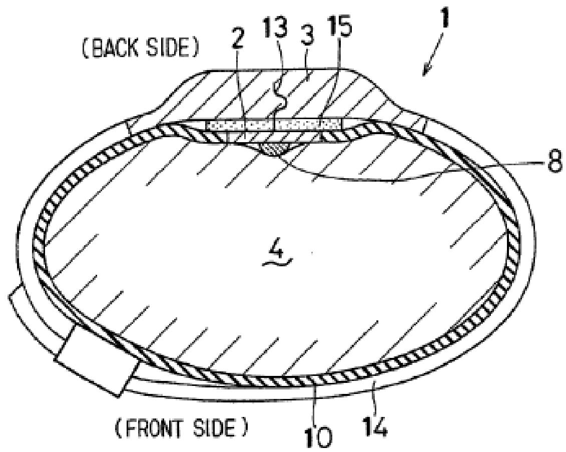

Figure 1 illustrates a cross-sectional view of pulse wave sensor 1 attached on the back side of user's wrist 4. *Id.* ¶¶ 12, 16. Pulse wave sensor 1 includes detecting element 2 and sensor body 3. *Id.* ¶ 16.

Figure 2 of Ohsaki, reproduced below, illustrates further detail of detecting element 2.

FIG. 2

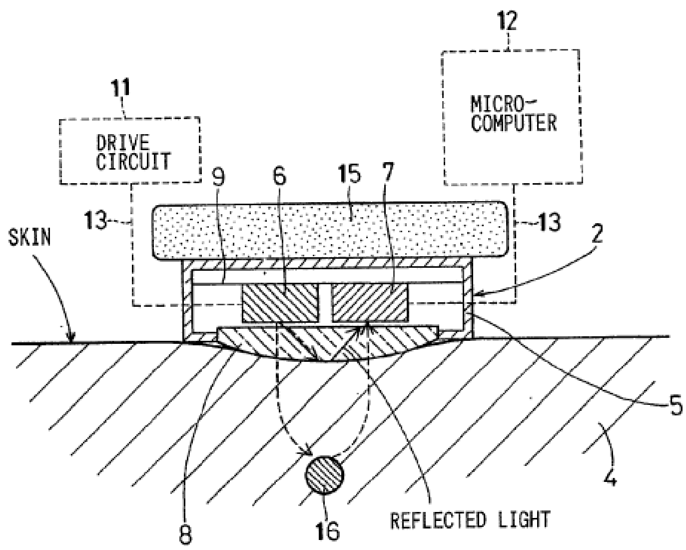

Figure 2 illustrates a mechanism for detecting a pulse wave. *Id.* ¶ 13. Detecting element 2 includes package 5, light emitting element 6, light receiving element 7, and translucent board 8. *Id.* ¶ 17. Light emitting element 6 and light receiving element 7 are arranged on circuit board 9 inside package 5. *Id.* ¶¶ 17, 19.

"[T]ranslucent board 8 is a glass board which is transparent to light, and attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8." *Id.* ¶ 17. "[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin," preventing detecting element 2 from slipping off the detecting position of the user's wrist. *Id.* ¶ 25. By preventing the detecting element from moving, the convex surface suppresses "variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the

user's skin." *Id.* Additionally, the convex surface prevents penetration by "noise such as disturbance light from the outside." *Id.*

Sensor body 3 is connected to detecting element 2 by signal line 13. *Id.* ¶ 20. Signal line 13 connects detecting element 2 to drive circuit 11, microcomputer 12, and a monitor display (not shown). *Id.* Drive circuit 11 drives light emitting element 6 to emit light toward wrist 4. *Id.* Detecting element 2 receives reflected light which is used by microcomputer 12 to calculate pulse rate. *Id.* "The monitor display shows the calculated pulse rate." *Id.*

4. Mendelson-2006 (Ex. 1010)

Mendelson-2006 is a journal article titled "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," and discloses a wireless wearable pulse oximeter connected to a personal digital assistant ("PDA"). Ex. 1010, 1.[4]

Figure 1 of Mendelson-2006 is reproduced below.

[4] Petitioner cites to the page numbers added to Exhibit 1010, rather than the native page numbering that accompanies the article. *See, e.g.*, Pet. 20–22. We follow Petitioner's numbering scheme.

Figure 1 illustrates a sensor module attached to the skin (top), and a photograph of a disassembled sensor module and receiver module (bottom). The sensor module includes an optical transducer, a stack of round printed circuit boards, and a coin cell battery. *Id.* at 2.

Figure 2 of Mendelson-2006 is reproduced below.

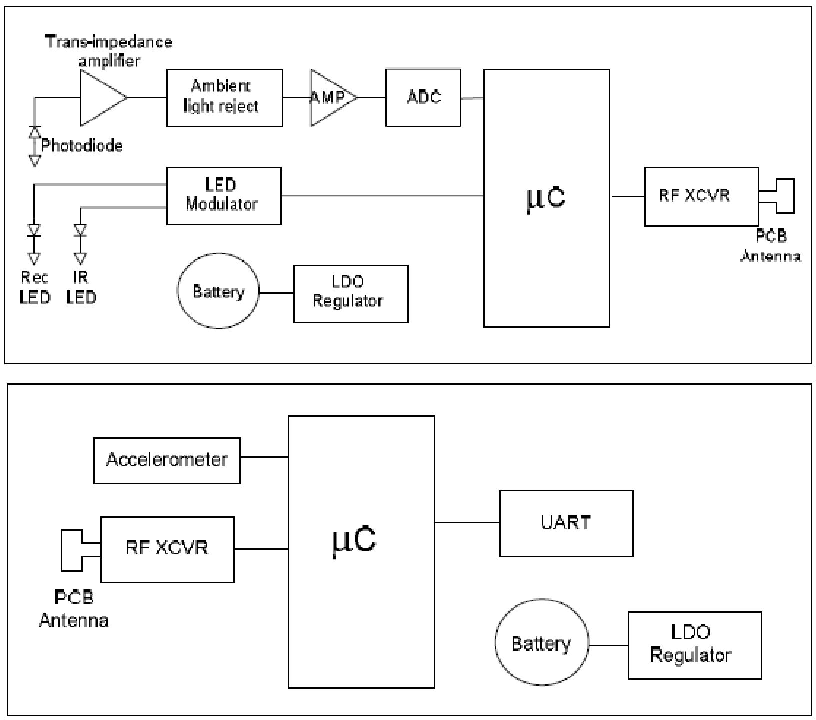

Figure 2 depicts a system block diagram of the wearable, wireless, pulse oximeter including the sensor module (top) and the receiver module (bottom). *Id.* The sensor module includes at least one light-emitting diode ("LED"), a photodetector, signal processing circuitry, an embedded microcontroller, and an RF transceiver. *Id.* at 1–2. Mendelson-2006 discloses that a concentric array of discrete photodetectors could be used to increase the amount of backscattered light detected by a reflectance type pulse oximeter sensor. *Id.* at 4. The receiver module includes an embedded

microcontroller, an RF transceiver for communicating with the sensor module, and a wireless module for communicating with the PDA. *Id.* at 2.

As a PDA for use with the system, Mendelson-2006 discloses "the HP iPAQ h4150 PDA because it can support both 802.11b and Bluetooth™ wireless communication" and "has sufficient computational resources." *Id.* at 3. Mendelson-2006 further discloses that

> [t]he use of a PDA as a local terminal also provides a low-cost touch screen interface. The user-friendly touch screen of the PDA offers additional flexibility. It enables multiple controls to occupy the same physical space and the controls appear only when needed. Additionally, a touch screen reduces development cost and time, because no external hardware is required. . . . The PDA can also serve to temporarily store vital medical information received from the wearable unit.

Id.

The PDA is shown in Figure 3 of Mendelson-2006, reproduced below.

Figure 3 illustrates a sample PDA and its graphical user interface ("GUI"). *Id.* Mendelson-2006 explains that the GUI allows the user to interact with the wearable system. *Id.* "The GUI was configured to present the input and

output information to the user and allows easy activation of various functions." *Id.* "The GUI also displays the subject's vital signs, activity level, body orientation, and a scrollable PPG waveform that is transmitted by the wearable device." *Id.* For example, the GUI displays numerical oxygen saturation ("SpO_2") and heart rate ("HR") values. *Id.*

5. Independent Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006. Pet. 41–65. Below, we set forth how the combination of prior art references teaches or suggests the claim limitations that are not disputed by the parties. For those limitations and reasons for combining the references that are disputed, we examine each of the parties' contentions and then provide our analysis.

i. "A physiological measurement system comprising"

The cited evidence supports Petitioner's undisputed contention that Aizawa satisfies the subject matter of the preamble.[5] Pet. 41; *see, e.g.*, Ex. 1006 ¶ 2 ("The present invention relates to a pulse wave sensor for detecting the pulse wave of a subject.").

ii. "[a] a physiological sensor device comprising"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses a physiological sensor device including a pulse rate detector. Pet. 41–43; *see, e.g.*, Ex. 1006 ¶ 23 (pulse wave sensor 2), Figs. 1(a)–(b).

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[5] Whether the preamble is limiting need not be resolved because Petitioner shows sufficiently that the preamble's subject matter is satisfied by the art.

iii. "[b] a plurality of emitters configured to emit light into tissue of a user"

Petitioner's Undisputed Contentions

Petitioner contends that Aizawa discloses an emitter—LED 21—and also states that, in certain embodiments, multiple LEDs may be employed. Pet. 13, 22. Patent Owner does not dispute this contention, and we agree with Petitioner. *See* Ex. 1006 ¶¶ 23 ("LED 21"), 32 ("The arrangement of the light emitting diode 21 and the photodetectors 22 is not limited to this."). For example, Aizawa explains that "[t]he same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector." *Id.* ¶ 33.

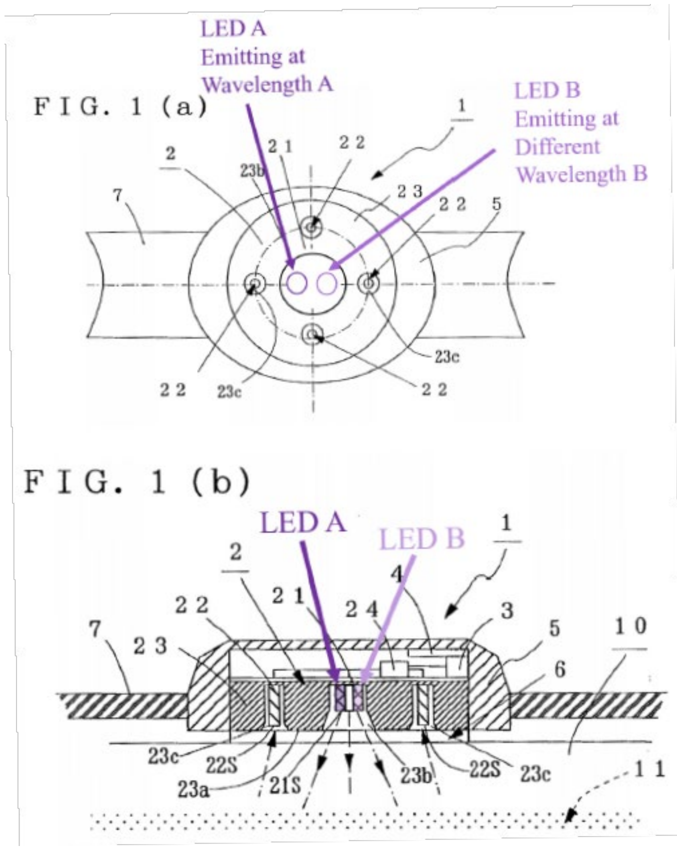
Petitioner also contends that Inokawa teaches a sensor with two LEDs–a green LED to sense pulse and an infrared LED to sense body motion. Pet. 16, 23. Petitioner also contends that when Inokawa's sensor is mounted on a base device, the infrared LED also is used to wirelessly transmit vital information to the base device. *Id.* at 17–18, 23–24. Patent Owner does not dispute these contentions, and we agree. Inokawa teaches a pair of LEDs 21, 23, where "the basic function of the S-side green LED 21 is to sense the pulse from the light reflected off of the body . . ., while the S-side infrared LED 23 serves to sense body motion from the change in this reflected light." Ex. 1008 ¶¶ 58–59. Inokawa also explains that "vital sign information stored in the memory 63 [of the sensor], such as pulse and body motion, is transmitted to the base device 17 using the S-side infrared LED 23 of the pulse sensor 1 and the B-side PD 45 of the base device 17," such that "there is no need to use a special wireless communication circuit or a communication cable." *Id.* ¶¶ 76–77.

Petitioner's Disputed Contentions

Moreover, Petitioner contends that a person of ordinary skill in the art would have been motivated to modify Aizawa "to include an additional LED as taught by Inokawa to improve the detected pulse wave by distinguishing between blood flow detection and body movement." Pet. 23–24, 26, 43–45. According to Dr. Kenny, "one of ordinary skill would have recognized that this would improve Aizawa's sensor by enabling it to account for motion load through use of the second LED, by detecting and recording body motion in addition to blood flow." Ex. 1003 ¶ 120 (cited at Pet. 43).

As a second and independent motivation, Petitioner also contends that such a modification also would have provided "additional functionality, including that of a wireless communication method," which would have "eliminate[d] problems associated with a physical cable, and, as taught by Inokawa, without requiring a separate RF circuit." Pet. 23–24. Petitioner contends that although Aizawa discloses data transmission, Aizawa "is silent about how such transmission would be implemented." *Id.* at 24. According to Petitioner, a skilled artisan "would have recognized that Aizawa's LED could have been used for wireless data communication with a personal computer to eliminate problems associated with a physical cable, and, as taught by Inokawa, without requiring a separate RF," which "would result in enhanced accuracy of the transmitted information." *Id.* According to Dr. Kenny, "as one of ordinary skill would have recognized, the LEDs provided on the sensor can be used not only to detect pulse rate, but also to 'accurately, easily, and without malfunction' transmit sensed data to a base station." Ex. 1003 ¶ 122.

To illustrate its proposed modification, Petitioner includes annotated and modified views of Aizawa's Figures 1(a) and 1(b), reproduced below. Pet. 25; *see also id.* at 44 (similar figures); Ex. 1003 ¶ 76.



Petitioner's annotated and modified figures depict the sensor of Aizawa with an added "LED B" (illustrated in light purple), as Petitioner contends would have been rendered obvious by Inokawa. *Id.* at 26–27, 44–45; *see also* Ex. 1003 ¶¶ 71–79, 110–129.

<u>Patent Owner's Arguments</u>

Patent Owner disputes Petitioner's contentions regarding the obviousness of modifying Aizawa to include two emitters. *See* PO Resp. 51–58; Sur-reply 23–25.

First, Patent Owner argues that neither Aizawa nor Inokawa discloses a device with both multiple detectors *and* multiple emitters in the *same* sensor, because Aizawa's embodiments have either a single emitter and multiple detectors (e.g., Ex. 1006, Fig. 1(a)) or multiple emitters and a single detector (e.g., *id.* ¶ 33), and Inokawa discloses multiple emitters and a single detector (e.g., Ex. 1008, Fig. 2). *See* PO Resp. 51–52 (citing, e.g., Ex. 1006 ¶ 33, Figs. 1, 2, 4, 5; Ex. 1008 ¶ 58, Fig. 2; Ex. 2004 ¶¶ 100–102). Patent Owner concludes, therefore, that a person of ordinary skill in the art would not have added a second emitter to Aizawa, when Aizawa already discloses an embodiment with multiple LEDs, i.e., an embodiment with only a single detector. PO Resp. 52 (citing, e.g., Ex. 2004 ¶ 103). Patent Owner argues that Dr. Kenny's testimony in this regard "conflicts with the references themselves" and so "is not credible." PO Resp. 35–36 (citing Ex. 1003 ¶¶ 55, 77).

Second, Patent Owner argues that the evidence does not support either of Petitioner's two proffered motivations for modifying Aizawa to include two emitters. As to the first motivation (to measure body movement using a second emitter), Patent Owner asserts that Dr. Kenny erroneously testifies that Aizawa cannot do this with its single emitter. PO Resp. 53 (citing, e.g., Ex. 1006 ¶ 15; Ex. 2007, 400:7–401:10; Ex. 2004 ¶ 104). Patent Owner argues that "Petitioner admits that Aizawa's sensor 'already records and accounts for' motion load." PO Resp. 53 (citing, e.g., Pet. 26; Ex. 1006 ¶ 15; PO Resp. 36; Ex. 2004 ¶ 84). Thus, Patent Owner contends that the proposed motivation would not realize an improvement over Aizawa alone. *Id.*

As to Petitioner's second motivation (to enable transmission of data to a base device using an optical communication link), Patent Owner argues that "Aizawa ***already*** includes a wireless transmitter . . . so Aizawa does not need to incorporate Inokawa's base device [optical] data transmission arrangement." PO Resp. 54 (citing, e.g., Ex. 1006 ¶¶ 23, 28, 35; Ex. 2004 ¶¶ 105–106). Indeed, Patent Owner argues "Dr. Kenny acknowledged Aizawa identifies no problems with Aizawa's form of data transmission." *Id.* at 55 (citing Ex. 2007, 409:13–410:2). Patent Owner further argues that "Aizawa's goal is 'real-time measuring' with the transmitter 'transmitting the measured pulse rate data to a display'" but that "Inokawa's data transfer approach does ***not*** allow real-time display of measurements." *Id.* at 55 (citing, e.g., Ex. 1006 ¶¶ 4, 15; Ex. 1008 ¶¶ 70, 74; Ex. 2004 ¶ 107). Patent Owner insists Inokawa does not aid Petitioner's case, because Inokawa discloses the benefits of using a second emitter in only two situations, i.e., first, to improve over a "cable" communication and, second, to avoid use of a "dedicated wireless communication circuit," whereas "Aizawa ***already*** incorporates a transmitter into its design." *Id.* at 56 (citing, e.g., Ex. 1008 ¶ 4; Ex. 1006 ¶¶ 23, 28; Ex. 2004 ¶ 108).

Third, Patent Owner accuses Petitioner and Dr. Kenny of overlooking further complications that would ensue from modifying Aizawa to have two emitters. Patent Owner argues that Dr. Kenny overlooked how placing "two LEDs in close proximity may cause thermal interference that could create significant issues for sensor performance," and would require "structural changes" to Aizawa's configuration. PO Resp. 57 (citing, e.g., Ex. 2004 ¶¶ 109–110; Ex. 1019, 59–60). Patent Owner also argues that "Petitioner widened Aizawa's emitter cavity to accommodate the extra LED with ***no***

explanation or recognition of this change," which could impact optical performance of the device. *Id.* at 57–58 (citing, e.g., Ex. 2004 ¶¶ 109–111).

<u>Petitioner's Reply</u>

Concerning Petitioner's first motivation, Petitioner asserts that Aizawa "is silent on whether it uses the computed motion load to improve the detection signal" and thereby provide a "more reliable" pulse reading, which is Petitioner's asserted improvement to Aizawa. Pet. Reply 28–29 (citing, e.g., Ex. 1003 ¶¶ 61–63, 71–72; Ex. 2007, 401:11–402:4; Ex. 1047 ¶ 51). Moreover, Petitioner contends that by using multiple LEDs at different wavelengths, "two separate signals [can] be collected[, which] allows noise arising from body motion to be better isolated and accounted for." *Id.* at 29 (citing Ex. 1047 ¶ 51).

Concerning Petitioner's second motivation, Petitioner maintains that Inokawa's use of two emitters having different wavelengths to upload data to a base device using optical communication advantageously improves the accuracy of the transmission by providing checksum information. Pet. Reply 22–23 (citing, e.g., Ex. 1003 ¶ 123; Ex. 2007, 407:7–408:20, 416:5–15; Ex. 1047 ¶ 52).

As to the "other complications" that Patent Owner alleges would result from the proposed modification, Petitioner asserts "such minor issues are 'part of what [a person of ordinary skill in the art] would bring . . . to the problem and would know how to make the changes needed.'" Pet. Reply 29–30 (quoting Ex. 2007, 384:8–388:12; Ex. 1047 ¶ 53).

<u>Patent Owner's Sur-reply</u>

Concerning Petitioner's first motivation, Patent Owner argues that Inokawa's disclosure is just as sparse as Aizawa's disclosure regarding how to use optical data to measure body movement. Sur-reply 23 (citing Ex. 1008 ¶ 59). Patent Owner also asserts that "Petitioner cites nothing in Inokawa that suggests" that Inokawa's two emitter data gathering is more reliable or otherwise superior to Aizawa's single emitter data gathering. *Id.* at 23–24.

Concerning Petitioner's second motivation, Patent Owner argues that the proposed modification eliminates Aizawa's ability to conduct "real-time collection and display of physiological measurements—a key goal of Aizawa's system." *Id.* at 24.

Patent Owner also faults Petitioner for not specifying how a person of ordinary skill in the art would have solved the alleged "additional cost, energy use, and thermal problems" that would ensue from using two emitters in the Aizawa device. *Id.* at 24–25.

<u>Analysis</u>

Upon review of the foregoing, we conclude a preponderance of the evidence supports Petitioner's contention that it would have been obvious to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, in light of Inokawa.

First, a person of ordinary skill in the art would have been motivated to make this replacement to improve the pulse measurements recorded by Aizawa's detector 1. Inokawa teaches that the infrared LED's signal can be used "to detect vital signs" such as "body motion," and the green LED's

signal can be "used to detect pulse." Ex. 1008, Fig. 2, ¶¶ 14, 58–59; Ex. 1003 ¶¶ 64, 72, 75–78; Ex. 1047 ¶¶ 50–51.

Patent Owner correctly points out that Aizawa describes its single-emitter detector 1 as transmitting its pulse data to "a device for computing the amount of motion load from the pulse rate." Ex. 1006 ¶¶ 15, 28, 35. But, this description is the only disclosure in Aizawa cited by Patent Owner as relating to computing a motion characteristic of the user. Further, we are unable to discern any other disclosure in Aizawa relating to motion computation, or what Aizawa proposes to do with its motion computation. *See id.* Based on the sparse nature of Aizawa's disclosure concerning motion load, it is not clear exactly what Aizawa proposes to do with the computed motion load, after it is computed. *See, e.g.*, Ex. 1047 ¶ 51 ("Aizawa is silent on whether it uses the computed motion load to improve the detection signal."). Aizawa does, however, describe the motion load as being computed "from the pulse rate," rather than being an input to the pulse rate calculation. Ex. 1006 ¶¶ 15, 35.

Dr. Kenny, when asked whether it was his understanding that "Aizawa's sensor could not account for motion load?", answered that "Aizawa's sensor attempts to prevent motion load rather than account for it." Ex. 2007, 400:7–11. He explained that, because Aizawa uses only a single emitter with a single wavelength, "what [Aizawa] sees as a signal would be some mixture of pulse rate and motion load if there was no effort to prevent motion load," so Aizawa seeks to solve the problem of "prevent[ing] motion load from corrupting the pulse rate signal." *Id.* at 400:12–401:10.
Dr. Kenny did not further explain this distinction between preventing and accounting for motion load in his deposition testimony cited by the parties as

relating to this issue. *Id.* at 400:7–402:4. We do not rely on this distinction as a basis for our present decision, because we find no express support for it in Aizawa's disclosure (*see* Ex. 1006 ¶¶ 15, 28, 35), and it is not explained in persuasive detail by Dr. Kenny.

We nonetheless credit Dr. Kenny's declaration testimony that a person of ordinary skill in the art, upon reviewing Inokawa's disclosure of using two emitters of different wavelengths to calculate a user's pulse and motion separately, would understand that these two separate measurements would enable the device to calculate a "more reliable" pulse rate because it "allows noise arising from body motion to be better isolated and accounted for." Ex. 1047 ¶ 51; *see also* Ex. 1003 ¶¶ 73, 77, 122–123, 126. Aizawa does not disclose using the computed motion load in this fashion, so it appears that this would improve upon the accuracy of Aizawa's pulse measurements, by using the computed motion load to isolate and account for noise. *See* Ex. 1006 ¶¶ 15, 28, 35.

Dr. Madisetti also offers no meaningful opposing testimony in this regard. *See, e.g.*, Ex. 2004 ¶ 104. Instead, Dr. Madisetti incorrectly reads Dr. Kenny's motivation testimony as being limited to the desirability of adding the bare ability to measure body movement to Aizawa. *See id.* In fact, Dr. Kenny further testified that it would have been beneficial to *use* the measured body movement to *improve* the pulse measurement of the device. *See* Ex. 1003 ¶ 120; Ex. 1047 ¶ 51. Dr. Madisetti does not address that testimony. *See* Ex. 2004 ¶ 104.

Thus, because Dr. Madisetti's testimony sets up a straw man to attack, rather than directly addressing the entirety of Dr. Kenny's testimony in this regard, Dr. Kenny's testimony stands unrebutted in the record before us.

Dr. Kenny's testimony also makes intuitive sense that measuring the user's motion *separately* from the user's pulse, for example by using two interrogating emitters of two different wavelengths, would provide a reliable means of correcting the pulse data for motion artifacts by using the separately measured motion data, rather than by trying to segregate these two components in the single data stream provided by Aizawa's single emitter device. *See, e.g.*, Ex. 1047 ¶ 51. We, therefore, are persuaded by Dr. Kenny's unrebutted testimony that using two emitters of different wavelengths would improve Aizawa's device in this way.

Independently, we are also persuaded that a person of ordinary skill in the art would have been motivated to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, to provide a reliable method of uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for display to the user. Inokawa expressly touts such optically-based uploading of data from Inokawa's wrist-worn sensor 1 to Inokawa's base device 17 as a benefit of incorporating two emitters in sensor 1. *See* Ex. 1008, Figs. 3, 19, ¶¶ 3–7, 14, 76–77, 109–111. Inokawa identifies two specific benefits of this optically-based data communication means. First, the infrared LED can transmit the pulse data, and the green LED can separately transmit "checksum" information to increase the accuracy of data transmission. *Id.* at Fig. 19, ¶¶ 14, 109–111. Second, using light emitters in this fashion to perform two functions (data collection by emitting light into the user's wrist, and data transmission by emitting light to photodetectors in a base device) obviates the need for providing "a special wireless communication circuit [in the wrist-worn sensor 1] or a communication cable." *Id.* ¶¶ 3–7, 76–77.

Patent Owner correctly points out that Aizawa already has a "transmitter" 4 for uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for processing and for display to the user. Ex. 1006, Fig. 1(b), ¶¶ 15, 23, 28, 35. However, Aizawa's Figure 1(b) illustrates transmitter 4 only as an empty box contained within outer casing 5, and Aizawa's written description does not provide further structural details concerning transmitter 4. *See id.* In particular, Aizawa does not describe exactly how transmitter 4 transmits its data to the other device. *See id.*

Patent Owner contends, and Dr. Madisetti and Dr. Kenny both testify, that Aizawa's transmitter 4 is a "wireless" transmitter. *See, e.g.*, PO Resp. 54; Ex. 2004 ¶¶ 49, 105–106, 112; Ex. 2007, 403:17–22, 414:19–21. They all appear to equate "wireless" communication to radio frequency communication, and not to include optical communication, even though both radio frequency and optical communication do not use a wire. Petitioner disagrees that Aizawa discloses any specific form of data transmission, including wireless transmission. *See* Tr. 71:5–72:3 ("[T]he transmitter disclosure in Aizawa, they don't say its's a wireless transmitter. That was a conjuration by [Patent Owner]. They don't specify whether it's a wired or wireless."). We assume, for this decision, that Aizawa expressly contemplates radio frequency communication as one embodiment by which transmitter 4 may transmit data to devices other than detector 1.

Patent Owner argues, and Dr. Madisetti testifies, that Aizawa's express disclosure goes even further. They assert Aizawa's "goal" is to measure and display pulse data *in real time during exercise*, using the wireless transmitter. *See, e.g.*, Ex. 2004 ¶¶ 106–108, 111. We find that

Aizawa does not support this assertion. Instead, Aizawa discusses prior art devices that "estimat[e] a burden on the heart of a person who takes exercise by *real-time measuring* his/her heart rate at the time of exercise" (Ex. 1006 ¶ 4 (emphasis added)), and then describes Aizawa's detector 1 as having a transmitter for transmitting the measured pulse rate data to another device for display (*id.* ¶ 15). Aizawa does not indicate when this transmission occurs. Aizawa also refers to "noise caused by the shaking of the body of the subject" as a problem to be addressed (*id.* ¶ 6), but this problem occurs regardless of whether the shaking results from exercise or the normal movement of the user's wrist over the course of the day. Thus, Aizawa does not tout, as an important feature of Aizawa's invention, the *real time display* of pulse rate data during exercise, regardless of whether the data gathered by Aizawa's wrist-worn detector 1 is transmitted wirelessly or otherwise. *Id.* ¶¶ 4, 6, 15.

No doubt, a person of ordinary skill in the art would have viewed the capability of a wrist-worn pulse detector to transmit its pulse data to another device for display in real time while the user is exercising to be a desirable feature in some cases, even if this is not one of Aizawa's specifically stated goals. *See, e.g.*, Ex. 1003 ¶ 67 (Dr. Kenny stating: "By wirelessly transmitting the collected data wirelessly, Mendelson 2006's system provides 'numerous advantages,' . . . ."); Ex. 2009, 393:6–14 (Dr. Kenny agreeing that a person of ordinary skill in the art "would have seen the ability to wirelessly transmit collected data as an advantage"). Nonetheless, Inokawa expressly discloses that, in other cases, the benefits achieved by wireless transmission can be outweighed by obviating the need for the wrist-worn sensor to include a special wireless communication circuit. *See*

Ex. 1008 ¶¶ 3–7 (discussing problems associated with wireless transmission, such as the need for a dedicated circuit, which is avoided by Inokawa's system that risks "few malfunctions" and has a "simple structure"), 76–77 ("As a result, there is no need to use a special wireless communication circuit . . ., which makes it possible to transmit vital sign information to the base device 17 accurately, easily, and without malfunction."). We therefore conclude that Petitioner's case for obviousness in this regard is supported by a preponderance of the evidence. *See, e.g.*, *In re Urbanski*, 809 F.3d 1237, 1243–44 (Fed. Cir. 2016) (persons of ordinary skill in the art may be motivated to pursue desirable properties of one prior art reference, even at the expense of foregoing a benefit taught by another prior art reference).

We disagree with Patent Owner's argument that Petitioner's case for obviousness is deficient on the basis that neither Aizawa nor Inokawa expressly discloses a wrist-worn sensor device that has *both* a plurality of emitters *and* at least four detectors, as claim 1 recites. Obviousness does not require "'some motivation or suggestion to combine the prior art teachings' [to] be found in the prior art." *KSR*, 550 U.S. at 407, 415–418. Nor does it require the bodily incorporation of Inokawa's device into Aizawa's device. *See, e.g.*, *In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (test for obviousness is not whether the features of one reference may be bodily incorporated into the structure of the other reference, but rather is "what the combined teachings of the references would have suggested to those of ordinary skill in the art"); *see also In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) (nonobviousness is not established by attacking references individually when unpatentability is predicated upon a combination of prior art disclosures). Instead, "[a] person of ordinary skill is also a person of

ordinary creativity, not an automaton," and "in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle." *KSR*, 550 U.S. at 420–421.

In this case, we are persuaded that a person of ordinary skill in the art would have been motivated to modify Aizawa's wrist-worn detector 1 to replace its single near infrared LED 21 with an infrared LED and a green LED, based on Inokawa, for all the reasons provided above. A person of ordinary skill in the art would additionally have known to keep all four detectors 22 that are already present in Aizawa's detector 1, so that "[e]ven when the attachment position of the sensor is dislocated, a pulse wave can be detected accurately," as disclosed by Aizawa. Ex. 1006 ¶¶ 9, 27. In short, the combination of Aizawa and Inokawa teaches that having multiple emitters is beneficial, and having multiple detectors is beneficial, for different and not inconsistent reasons.

Finally, we agree with Petitioner's position that any thermal interference and power consumption issues that may arise in Aizawa's wrist-worn pulse detector, by using two emitters instead of one emitter, are well within the capabilities of POSITA to solve. We credit Dr. Kenny's testimony in this regard. *See* Ex. 1003 ¶¶ 78–79, 121; Ex. 1047 ¶ 53. For example, Dr. Kenny acknowledges that Aizawa already discloses adding additional emitters. Ex. 1003 ¶ 71 (citing Ex. 1006 ¶¶ 32–33). Dr. Kenny further testifies that this modification "amount[s] to nothing more than the use of a known technique [i.e., Inokawa's use of two emitters in a wrist-worn pulse detector] to improve similar devices [i.e., Aizawa's wrist-worn pulse detector] in the same way, and combining prior art elements according to known methods to yield predictable results." *Id.*

¶¶ 78 ("Furthermore, one of ordinary skill would have readily understood how to select different photodiodes with different sensitivities to detect the different wavelengths of light emitted by the two LEDs."), 121.

Patent Owner cites several portions of Dr. Kenny's deposition testimony that, in Patent Owner's view, indicate Dr. Kenny fails to appreciate the significance of the thermal effects, optical interference complications, and power consumption needs, that are posed by adding a second emitter to Aizawa's device, and fails to explain how these issues would have been overcome. *See* PO Resp. 55, 57–58 (citing Ex. 2007, 379:17–21, 384:8–388:16, 394:11–395:22, 405:2–11, 409:13–410:2; Ex. 2009, 381:18–382:8, 383:22–385:9, 390:5–392:3). We have reviewed this deposition testimony, and we conclude Patent Owner overstates its significance. It establishes, at most, that Dr. Kenny did not expressly address these issues in his declaration (Exhibit 1003), but Dr. Kenny's opinion is that these issues would have been within the capability of a person of ordinary skill in the art to resolve. Based on the evidentiary record presented to us, we agree with Dr. Kenny. For example, Inokawa discloses a wrist-worn pulse sensor 1 having two emitters 21 and 23 in close proximity to each other. *See* Ex. 1008, Figs. 1–2. An artisan must be presumed to know something about the art apart from what the relied-upon references disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962).

Dr. Madisetti's testimony opposing Dr. Kenny's foregoing opinion is premised solely on Dr. Kenny's alleged failure to explain how the issues that arise from adding a second emitter to Aizawa would have been solved; Dr. Madisetti does not provide any affirmative reason why these issues would have been difficult for a person of ordinary skill in the art to solve, in

the context of Aizawa's device or wrist-worn pulse sensing devices in general. *See* Ex. 2004 ¶ 109.

Thus, we conclude a person of ordinary skill in the art would have been motivated to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, and would have had a reasonable expectation of success in doing so.

iv. "[c] at least four detectors, wherein each of the at least four detectors has a corresponding window that allows light to pass through to the detector"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses at least four detectors, each stored in a separate cavity 23c, which would have been understood to be "openings or windows that mirror specific detector placement layouts." Pet. 45, 49–51; *see, e.g.*, Ex. 1006 ¶¶ 23 ("four phototransistors 22"), 24 ("stored in cavities" and "set back from . . . detection face 23a"), Figs. 1(a)–1(b); Ex. 1003 ¶¶ 138–143.

v. "[d] a wall that surrounds at least the at least four detectors"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses holder 23, which is a wall that surrounds detectors 22, as well as other elements. Pet. 51–52; *see, e.g.*, Ex. 1006 ¶ 23 ("holder 23 for storing . . . light emitting diode 21 and the photodetectors 22"), Fig. 1(b).

vi. "[e–g] a cover that operably connects to the wall and that is configured to be located between tissue of the user and the at least four detectors when the physiological sensor device is worn by the user, wherein: the cover comprises a single protruding convex surface, and at least a portion of the cover is sufficiently rigid to cause tissue of the user to conform to at least a portion of a shape of the single protruding convex surface when the physiological sensor device is worn by the user"

<u>Petitioner's Undisputed Contentions</u>

Petitioner contends that Aizawa discloses a cover, i.e., an "acrylic transparent plate positioned between the photodetectors and the wrist," to improve adhesion between the sensor and the subject's wrist. Pet. 15. Patent Owner does not dispute this contention, and we agree with Petitioner. Aizawa discloses that "acrylic transparent plate 6 is provided on the detection face 23a of the holder 23 to improve adhesion to the wrist 10." Ex. 1006 ¶ 34, Fig. 1(b) (depicting transparent plate 6 between sensor 2 and wrist 10).

Petitioner also contends that Ohsaki teaches a wrist-worn sensor that includes a "translucent board" having a convex surface that contacts the user's skin. Pet. 19, 34. Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki discloses that sensor 1 includes detecting element 2 and sensor body 3, and is "worn on the back side of the user's wrist." Ex. 1009 ¶ 16. Ohsaki discloses that detecting element 2 includes package 5 and "translucent board 8[,which] is a glass board which is transparent to light, [and is] attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8." *Id.* ¶ 17. As seen in Ohsaki's Figure 2, translucent board 8 has a single protruding convex surface, which is placed between a user's tissue and a light receiving element (e.g., photodetector) 7 when the sensor is worn. *Id.* at Fig. 2. As

also seen in Figure 2, the board 8 is operably connected to the walls of sensor package 5. *Id.* ¶ 17 ("The translucent board 8 is . . . attached to the opening of the package 5."), Fig. 2.

Petitioner also contends that Ohsaki's Figure 2 depicts the user's tissue conforming to the shape of the convex surface of the cover, such that the convex surface would have been understood to be "sufficiently rigid." Pet. 56. Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki's Figure 2 depicts the user's tissue 4 conforming to the shape of the protruding convex surface when the sensor is worn by the user. Ex. 1009 ¶ 17 ("The translucent board 8 is a glass board."), Fig. 2; *see, e.g.*, Ex. 1003 ¶¶ 160 (testifying as to the convex surface's rigidity), 164.

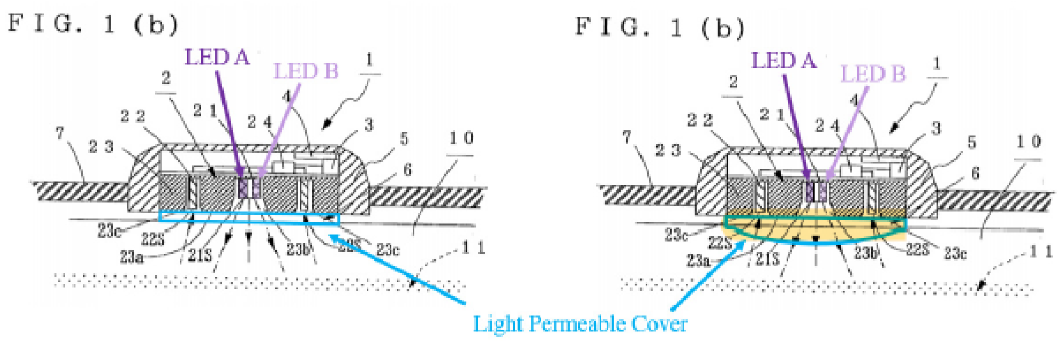
<u>Petitioner's Disputed Contentions</u>

Petitioner further contends that a person of ordinary skill in the art "would have found it obvious to modify the sensor's flat cover [in Aizawa] . . . to include a lens/protrusion . . . similar to Ohsaki's translucent board 8, so as to [1] improve adhesion between the user's wrist and the sensor's surface, [2] improve detection efficiency, and [3] protect the elements within sensor housing." Pet. 36–37 (citing, e.g., Ex. 1003 ¶¶ 94–97; Ex. 1009 ¶¶ 25), 53–54 (citing, e.g., Ex. 1003 ¶¶ 71–102). Petitioner contends that Ohsaki's convex surface is in "intimate contact" with the user's tissue, which prevents slippage of the sensor and increases signal strength because "variation of the amount of the reflected light . . . that reaches the light receiving element 7 is suppressed" and because "disturbance light from the outside" is prevented from penetrating board 8, as compared to a sensor with a flat surface. *Id.* at 34–36 (citing, e.g., Ex. 1003 ¶ 95; quoting Ex. 1009 ¶ 25).

Accordingly, Petitioner contends that a person of ordinary skill in the art would have modified Aizawa's sensor to include a cover with a single convex protrusion, as taught by Ohsaki, "that operably connects to the wall and that is configured to be located between tissue of the user and the at least four detectors when the sensor is worn by the user." Pet. 36–37 (citing, e.g., Ex. 1003 ¶¶ 94–97), 53–54 (citing, e.g., Ex. 1003 ¶¶ 147–153). Petitioner also contends that an ordinarily skilled artisan would have configured the cover to be "sufficiently rigid to cause tissue of the user to conform to the shape of the surface when worn by the user." *Id.* at 56 (citing, e.g., Ex. 1003 ¶¶ 61–69, 71–161).

Petitioner contends this modification would have been "nothing more than the use of a known technique to improve similar devices in the same way," i.e., "simply improving Aizawa-Inokawa's transparent plate 6 that has a flat surface to improve adhesion to a subject's skin and reduce variation in the signals detected by the sensor." Pet. 37 (citing Ex. 1003 ¶ 98). Further according to Petitioner, "the elements of the combined system would each perform functions they had been known to perform prior to the combination—Aizawa-Inokawa's transparent plate 6 would remain in the same position, performing the same function, but with a convex surface as taught by Ohsaki." *Id.* at 37–38 (citing, e.g., Ex. 1003 ¶¶ 94–99), 53–54 (citing Ex. 1003 ¶¶ 71–102).

To illustrate its proposed modification, Petitioner includes two annotated versions of Aizawa's Figure 1(b), both of which are reproduced below. Pet. 36–37 (citing Ex. 1003 ¶¶ 94–97), 53–54.



Petitioner's annotated figure on the left depicts Aizawa's sensor, modified to include LED B (*see supra* Section II.D.5.iii) and with a flat "light permeable cover" (illustrated with blue outline); Petitioner's annotated figure on the right depicts Aizawa's sensor, again modified to include LED B (*see supra* Section II.D.5.iii) and with a convex "light permeable cover" (illustrated with yellow shading and green outline).

<u>Patent Owner's Arguments</u>

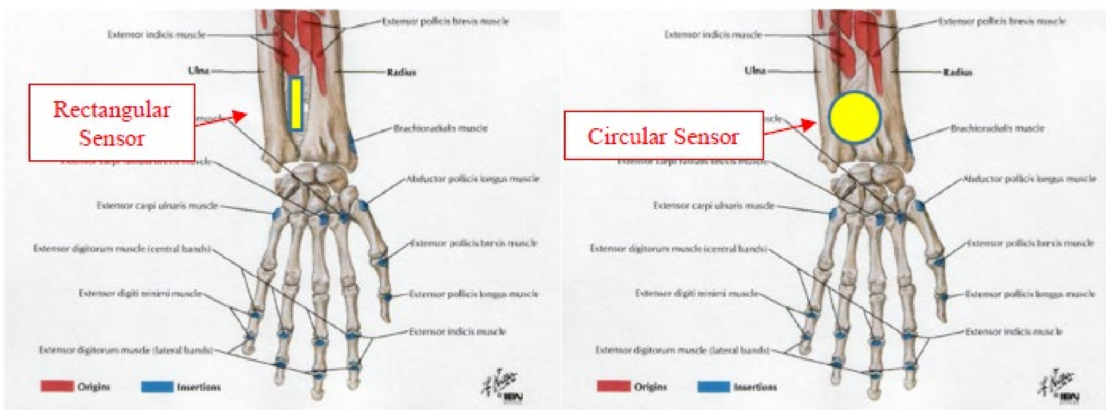
Patent Owner argues that a person of ordinary skill in the art would not have been motivated to modify Aizawa's sensor to include Ohsaki's convex cover. PO Resp. 20–51; PO Sur-Reply 3–22.

First, Patent Owner argues that the proposed modification "changes Ohsaki's structure and eliminates the longitudinal shape that gives Ohsaki's translucent board the ability to prevent slipping." PO Resp. 21. This argument is premised on Patent Owner's contention that Ohsaki's convex cover must be rectangular, with the cover's long direction aligned with the length of the user's forearm, to avoid interacting with bones in the wrist and forearm. *Id.* at 22–24 (citing, e.g., Ex. 2004 ¶¶ 52–54; Ex. 1009 ¶¶ 6, 19, 23, 24); *see also* PO Sur-reply 3–10. According to Patent Owner, Ohsaki teaches that "aligning the sensor's longitudinal direction with the

circumferential direction of the user's arm undesirably results in 'a tendency [for Ohsaki's sensor] to slip off.'" PO Resp. 23–24 (citing Ex. 1009 ¶ 19).

Thus, Patent Owner contends that Petitioner's proposed modification would "chang[e] Ohsaki's rectangular board into a circular shape," which "would eliminate the advantages discussed above" because it "cannot be placed in ***any longitudinal*** direction and thus cannot coincide with the longitudinal direction of the user's wrist." *Id.* at 24 (citing Ex. 2004 ¶¶ 55–57). Patent Owner presents annotated Figures depicting what it contends is Ohsaki's disclosed sensor placement as compared to that of the proposed modification, reproduced below.

Ohsaki's Longitudinal Teachings | Petitioner's Proposed Combination



Patent Owner's annotated Figure on the left depicts a rectangular sensor placed between a user's radius and ulna, while Patent Owner's annotated Figure on the right depicts a circular sensor placed across a user's radius and ulna. Based on these annotations, Patent Owner argues that the proposed "circular shape would press on the user's arm in all directions and thus cannot avoid the undesirable interaction with the user's bone structure," such that a skilled artisan "would have understood such a change would eliminate

Ohsaki's benefit of preventing slipping." *Id.* at 25 (citing, e.g., Ex. 2004 ¶¶ 54–61).

Second, Patent Owner argues that Ohsaki requires its sensor be placed on the back of the user's wrist to achieve any benefits, but that such a location would have been unsuitable for Aizawa's sensor. PO Resp. 30. Specifically, Patent Owner argues that Aizawa's sensor must be worn on the palm side of the wrist, close to radial and ulnar arteries, which is the side opposite from where Ohsaki's sensor is worn. *Id.* at 30–35 (citing, e.g., Ex. 1006 ¶¶ 2, 7, 9, 26, 27, 36; Ex. 2004 ¶¶ 66–70). According to Patent Owner, Ohsaki teaches that the sensor's convex surface has a tendency to slip when placed on the palm side of the wrist, i.e., in the location taught by Aizawa. *Id.* at 36–38 (citing, e.g., Ex. 1009 ¶¶ 19, 23, 24; Ex. 2004 ¶¶ 74–80). Thus, Patent Owner argues that a person of ordinary skill in the art "would not have been motivated to use Ohsaki's longitudinal board—designed to be worn on the ***back side*** of a user's wrist—with Aizawa's ***palm-side*** sensor." *Id.* at 39. Similarly, Patent Owner argues that Aizawa teaches away from the proposed modification because Aizawa teaches that its flat acrylic plate improves adhesion on the palm side of the wrist, while Ohsaki teaches that its convex board "has a tendency to slip" on the palm side of the wrist. *Id.* at 39–41 (citing, e.g., Ex. 2004 ¶¶ 82–84).

Third, Patent Owner argues that a person of ordinary skill in the art would not have placed Ohsaki's convex cover over Aizawa's peripheral detectors because the convex cover would condense light toward the center and away from Aizawa's detectors, which would decrease signal strength. PO Resp. 42–48 (citing, e.g., Ex. 2004 ¶¶ 85–97). Patent Owner also contends that Petitioner and Dr. Kenny admitted as much in a related

proceeding. *Id.* at 43–44 (citing, e.g., Ex. 2019, 45; Ex. 2020, 69–70). Patent Owner also relies on Figure 14B of the '554 patent to support its position. *Id.* at 44–45 (citing Ex. 1001, 36:3–6, 36:13–15). Additionally, Patent Owner argues that its position is also supported by Inokawa, which also uses a convex lens to direct light toward the center but, in Inokawa's structure, the light is directed from peripheral emitters toward a central detector. *Id.* at 48–50 (citing, e.g., Ex. 1008 ¶¶ 15, 58). In light of the foregoing, Patent Owner argues that a person of ordinary skill in the art would have understood that the proposed modification would have decreased signal strength by directing light away from Aizawa's peripheral detectors. *Id.* at 45–48.

Fourth and finally, Patent Owner argues that a person of ordinary skill in the art "would have understood that Aizawa's ***flat*** plate would provide better protection than a convex surface" because it "would be less prone to scratches." *Id.* at 50–51 (citing Ex. 1008 ¶ 106).

<u>Petitioner's Reply</u>

Concerning Patent Owner's first and second arguments, Petitioner responds that Ohsaki does not disclose the shape of its protrusion, other than its convexity as shown in Figures 1 and 2, nor does Ohsaki require a rectangular shape or placement on the back of the wrist in order to achieve the disclosed benefits. Pet. Reply 13–19 (citing, e.g., Ex. 1047 ¶¶ 16–27). Moreover, Petitioner asserts that "even if Ohsaki's translucent board 8 were somehow understood to be rectangular, obviousness does not require 'bodily incorporation' of features from one reference into another"; rather, a person of ordinary skill in the art "would have been fully capable of modifying Aizawa to feature a light permeable protruding convex cover to obtain the

benefits" taught by Ohsaki. *Id.* at 15–16 (citing, e.g., Ex. 1047 ¶ 21). Similarly, regarding the location of the sensor, Petitioner asserts,

> [E]ven assuming for the sake of argument that a POSITA would have understood Aizawa's sensor as being limited to placement on the palm side of the wrist, and would have understood Ohsaki's sensor's "tendency to slip" when arranged on the front side as informing consideration of Ohsaki's teachings with respect to Aizawa, that ***would have further motivated*** the [person of ordinary skill in the art] to implement a light permeable convex cover in Aizawa's sensor, to improve detection efficiency of that sensor when placed on the palm side.

Id. at 17 (citing, e.g., Ex. 1047 ¶ 25). In other words, Ohsaki's disclosure that a convex surface suppresses variation in reflected light would have motivated an artisan to add such a surface to Aizawa to improve detection efficiency of that sensor when placed on the palm side. *Id.* at 18.

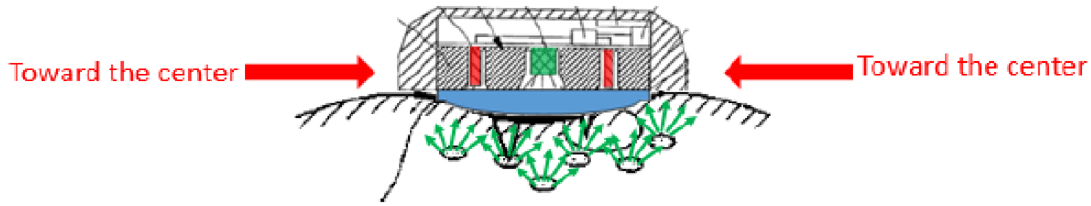
Concerning Patent Owner's third argument, Petitioner responds that adding a convex cover to Aizawa's sensor would not decrease signal strength but, instead, "would improve Aizawa's signal-to-noise ratio by causing more light backscattered from tissue to strike Aizawa's photodetectors than would have with a flat cover" because such a cover improves light concentration across the entire lens and does not direct it only towards the center. *Id.* at 20–28 (citing, e.g., Ex. 1047 ¶¶ 29–45).

Petitioner asserts that Patent Owner and Dr. Madisetti "ignore[] the well-known principle of reversibility," by which "a ray going from P to S will trace the same route as one from S to P." Pet. Reply 20–22 (quoting Ex. 1040, 92; citing, e.g., Ex. 1040, 87–92; Ex. 1049, 106–111; Ex. 1047 ¶ 31). When applied to Aizawa's sensor, Petitioner contends that any condensing benefit achieved by a convex cover would thus direct emitted light toward Aizawa's peripheral detectors. *Id.* at 21–22 (citing, e.g.,

Ex. 1047 ¶¶ 31–35). Although Dr. Madisetti "refused to acknowledge this basic principle of reversibility during deposition," Petitioner contends it is applied in Aizawa. *Id.* at 22 (citing, e.g., Ex. 1041, 89:12–19; Ex. 1003 ¶ 127 (citing Ex. 1006 ¶ 33); Ex. 1047 ¶ 34).

Petitioner also asserts that Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue will be scattered and diffuse and will approach the detectors "from various random directions and angles." Pet. Reply 22–24 (citing, e.g., Ex. 1019, 52, 86, 90; Ex. 1042, 803; Ex. 1047 ¶¶ 36–41; Ex. 2006, 163:12–164:2). This scattered and diffuse light, according to Petitioner, means that Ohsaki's convex cover cannot "focus all light at the center of the sensor device," as Patent Owner argues. *Id.* at 23. Instead, due to the random nature of this scattered light, Petitioner asserts that a person of ordinary skill in the art would have understood that "Ohsaki's convex cover provides at best a slight refracting effect, such that light rays that otherwise would have missed the detection area are instead directed toward that area as they pass through the interface provided by the cover." *Id.* at 24 (citing, e.g., Ex. 1047 ¶ 42). Petitioner applies this understanding to Aizawa, and asserts that using a cover with a convex protrusion in Aizawa would "enable backscattered light to be detected within a circular active detection area surrounding" a central light source, thereby "allow[ing] a larger fraction of light randomly backscattered from tissue to be detected within the active detection area surrounding [the light] source." *Id.* at 24–27 (citing, e.g., Ex. 1019, 86, 90; Ex. 1047 ¶¶ 42–48).

Petitioner relies upon the following illustration of this alleged effect. Pet. Reply 27 (citing Ex. 1047 ¶ 47).



The above illustration depicts backscattered light reflecting off user tissue in various directions, such that it impinges upon the peripheral detectors from various random angles and directions. *Id.* According to Petitioner, this "allow[s] the detector to capture light that otherwise would have been missed by the detectors, regardless of their location within the sensor device." *Id.*

Finally, Petitioner dismisses Patent Owner's reliance on Figure 14B of the '554 patent because it "is not an accurate representation of light that has been reflected from a tissue measurement site. For example, the light rays (1420) shown in FIG. 14B are collimated (i.e., travelling paths parallel to one another), and each light ray's path is perpendicular to the detecting surface." Pet. Reply 26 (citing, e.g., Ex. 1047 ¶ 45).

Concerning Patent Owner's fourth argument, Petitioner responds that even if a flat surface might be less prone to scratching, that possible disadvantage would have been weighed against the "known advantages of applying Ohsaki's teachings," and would not negate a motivation to combine. *Id.* at 28 (citing, e.g., Ex. 1047 ¶ 49).

<u>Patent Owner's Sur-reply</u>

Concerning Patent Owner's first and second arguments, Patent Owner reiterates its position that Ohsaki's purported benefits attach only to a sensor with a rectangular convex surface that is located on the back of the wrist,

and that "even small changes in sensor orientation or measurement location result in slippage." PO Sur-reply 3–14, 7.

Concerning Patent Owner's third argument, Patent Owner asserts that Petitioner's Reply improperly presents several new arguments, relying on new evidence, as compared with the Petition. *Id.* at 16 (regarding reversibility), 18–22.

Patent Owner argues that Dr. Kenny and Petitioner have not overcome their admissions that a convex lens directs light toward the center. *Id.* at 14–16, 19. Moreover, Patent Owner argues that Petitioner's discussion of the principle of reversibility is "irrelevant" because it "assumes conditions that are not present when tissue scatters and absorbs light." *Id.* at 16. The random nature of backscattered light, in Patent Owner's view, "hardly supports Petitioner's argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed," and is irrelevant to the central issue presented here of "whether changing Aizawa's flat surface to a convex surface results in more light on Aizawa's peripherally located detectors." *Id.* at 16–17.

Patent Owner also asserts that Petitioner mischaracterizes Patent Owner's position, which is not that Ohsaki's cover with a convex protrusion "focuses ***all*** light to a single point" at the center of the sensor as Petitioner characterizes it. PO Sur-reply 18–19. Patent Owner's position, rather, is that Petitioner has not shown that a person of ordinary skill in the art "would have been motivated to change Aizawa's flat surface to a convex surface to improve signal strength." *Id.* at 19. In Patent Owner's view, by arguing that the convex cover provides only a "slight refracting effect," Petitioner

undermines its contention that providing such a cover would have improved detection efficiency. *Id.*

Patent Owner also argues that Petitioner's contention that a convex cover allows more light collection generally is a new theory not supported by Dr. Kenny's original declaration. *Id.* at 20. Moreover, Patent Owner argues that "Petitioner's theory is unavailing because it fails to consider the greater ***decrease*** in light at the detectors due to light redirection to a ***more*** central location." *Id.* at 20–21. According to Patent Owner, any light redirected from the sensor's edge could not make up for the loss of signal strength from light redirected away from the detectors and toward the center. *Id.* at 21.

Concerning Patent Owner's fourth argument, Patent Owner argues that Petitioner does not dispute Patent Owner's position that a flat cover would be less prone to scratches and offers "***no*** plausible advantages for its asserted combination." *Id.* at 22. Moreover, Patent Owner argues that "the risk of scratches is not merely a disadvantage—it directly undermines Petitioner's motivation to add a convex cover to 'protect the elements within the sensor housing.'" *Id.*

Analysis

As noted above, Petitioner provides three rationales to support its contention that a person of ordinary skill in the art would have provided "a light permeable cover with a protruding convex surface," such as that taught by Ohsaki, to Aizawa's sensor: (1) to improve adhesion between the sensor and the user's tissue, (2) to improve detection efficiency, and (3) to protect the elements within the sensor housing. Pet. 36–37 (citing, e.g., Ex. 1003

¶¶ 94–97; Ex. 1009 ¶¶ 25). We conclude all three rationales are supported by the evidence, as follows.

Rationales 1 and 2

The evidence of record persuades us that adding a convex cover, such as that taught by Ohsaki, would have improved adhesion between the sensor and the user's skin, which would have increased the signal strength of the sensor. Ohsaki teaches as much:

> [T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby *it is prevented that the detecting element 2 slips off* the detecting position of the user's wrist 4. If the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4 as shown in Fig. 4B. However, in the case that the translucent board 8 has a convex surface like the present embodiment, the *variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed*. *It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8*. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25 (emphases added); *see also id.* ¶ 27 ("stably fixed").

We credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated by such teachings to apply a cover with a convex surface to Aizawa to improve that similar device in the same way and to yield predictable results, i.e., to resist movement of the sensor on the user's wrist. *See, e.g.*, Ex. 1003 ¶¶ 95 ("[T]his contact between the convex surface and the user's skin is said to prevent slippage, which increases the strength of the signals obtainable by Ohsaki's sensor."), 97. We also credit Dr. Kenny's testimony that, in light of these teachings, a person of ordinary

skill in the art would have made such a modification to improve the pulse sensor's ability to emit light into, and detect light reflected from, the user's wrist, to generate an improved pulse signal. Ex. 1003 ¶¶ 95, 97, 155; Ex. 1047 ¶¶ 12–13.

Indeed, Ohsaki expressly compares the performance of a wrist-worn pulse wave sensor depending on whether translucent board 8 is convex or flat, and concludes the convex surface results in improved performance over the flat surface, especially when the user is moving. Ex. 1009, Figs. 4A–4B, ¶¶ 15, 25 (stating that with "a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4," and with "a convex surface like the present embodiment, the variation of the amount of the reflected light" collected by the sensor "is suppressed"). Ohsaki also states that, with a convex surface, "[i]t is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8." *Id.* ¶ 25.

We also credit Dr. Kenny's testimony that the proposed modification would have been within the skill level of an ordinary artisan. For example, Dr. Kenny testifies:

> One of ordinary skill would have combined the teachings of Aizawa-Inokawa and Ohsaki as doing so would have amounted to nothing more than the use of a known technique to improve similar devices in the same way. One of ordinary skill would have recognized that incorporating Ohsaki's convex surface is simply improving Aizawa-Inokawa's transparent plate 6 that has a flat surface to improve adhesion to a subject's skin and reduce variation in the signals detected by the sensor. Furthermore, the elements of the combined system would each perform similar functions they had been known to perform prior to the combination—Aizawa-Inokawa's transparent plate 6

> would remain in the same position, performing the same function, but with a convex surface as taught by Ohsaki.

Ex. 1003 ¶ 98; *see also id.* ¶¶ 84–99, 155, 160. In light of Ohsaki's express disclosure of the benefits of a convex cover, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to modify Aizawa as proposed, and would have had a reasonable expectation of success in doing so.

We next address Patent Owner's first through third arguments, each of which implicates Petitioner's first and second asserted rationales of improved adhesion and detection efficiency.

Patent Owner's first argument is premised on the notion that Ohsaki's benefits only can be realized with a rectangular convex surface, because such a shape is required to avoid interacting with bones on the back of the user's forearm. PO Resp. 20–27. We disagree. Ohsaki does not disclose the shape of its convex cover, much less require it be rectangular. In fact, Ohsaki is silent as to the shape of the convex surface. Ohsaki discloses that sensor 1 includes detecting element 2, which includes package 5 within which the sensor components are located. Ex. 1009 ¶ 17. Ohsaki's convex surface is located on board 8, which is "attached to the opening of the package 5." *Id.* Ohsaki provides no further discussion regarding the shape of board 8 or its convex protrusion.

We disagree with Patent Owner's suggestion that the shape of the convex surface can be inferred to be rectangular from Ohsaki's Figures 1 and 2. PO Resp. 16–17. Ohsaki does not indicate that these figures are drawn to scale, or reflect precise dimensions or shapes of the convex surface. *See, e.g.*, Ex. 1009 ¶ 13 ("schematic diagram"); *see also* Pet.

Reply 14–15; *Hockerson-Halberstadt, Inc. v. Avia Group Int'l*, 222 F.3d 951, 956 (Fed. Cir. 2000) ("[I]t is well established that patent drawings do not define the precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue.").

To be clear, Ohsaki describes the shape of *detecting element 2* as rectangular: "[T]he length of the detecting element from the right side to the left side in FIG. 2 is longer than the length from the upper side to the lower side." Ex. 1009 ¶ 19. Ohsaki also describes that detecting element 2 is aligned longitudinally with the user's forearm: "[I]t is desirable that the detecting element 2 is arranged so that its longitudinal direction agrees with the longitudinal direction of the user's arm," to avoid slipping off. *Id.*; *see also id.* ¶ 9 ("The light emitting element and the light receiving element are arranged in the longitudinal direction of the user's arm.").

In light of this disclosed rectangular shape of detecting element 2, it is certainly possible that Ohsaki's convex surface may be similarly shaped. But, it may not be. Contrary to Patent Owner's argument, Ohsaki neither describes nor requires detecting element 2 to have the same shape as the convex surface of board 8. *Accord* Pet. Reply. 13–16 (noting also that Ohsaki's board 8 "is not coextensive with the entire tissue-facing side of detecting element 2"). We have considered the testimony of both Dr. Kenny and Dr. Madisetti on this point. Ex. 1047 ¶¶ 10–11, 14, 16–21; Ex. 2004 ¶¶ 36–41 (relying on Ohsaki's Figures 1–2 to support his opinion that the convex surface is rectangular). Dr. Madisetti's reliance on the dimensions of Ohsaki's figures is unpersuasive. *Hockerson-Halberstadt*, 222 F.3d at 956. We credit Dr. Kenny's testimony that Ohsaki does not describe its convex

surface as rectangular, because this testimony is most consistent with Ohsaki's disclosure.

Further, Patent Owner suggests that the convex surface *must be* rectangular, in order to avoid interacting with bones in the user's forearm. PO Resp. 22–23; PO Sur-Reply 9 ("[A] POSITA would have understood Ohsaki's convex board must ***also*** have a longitudinal shape oriented up-and-down the watch-side of the user's wrist/forearm."). Although Ohsaki recognizes that interaction with these bones can cause problems, (*see* Ex. 1009 ¶¶ 6, 19), we do not agree that the *only way* to avoid these bones is by aligning a rectangular cover with the longitudinal direction of the user's forearm. For example, in the annotated Figures provided by Patent Owner, *see* PO Resp. 23, we discern that the circular sensor that purports to depict the proposed modification would *also* avoid the bones in the forearm if it were slightly smaller. Patent Owner provides no persuasive explanation to justify the dimensions it provides in this annotated figure, or to demonstrate that such a large sensor would have been required. Indeed, we discern that it would have been within the level of skill of an ordinary artisan to appropriately size a modified sensor to avoid these well-known anatomical obstacles. "A person of ordinary skill is also a person of ordinary creativity, not an automaton." *KSR*, 550 U.S. at 421. After all, an artisan must be presumed to know something about the art apart from what the references disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962).

Finally, we do not agree with Patent Owner's position that Ohsaki's advantages apply only to rectangular convex surfaces. As discussed, Patent Owner has not shown that Ohsaki's convex surface is rectangular at all. Moreover, even if Ohsaki's convex surface is rectangular, when discussing

the benefits associated with a convex cover, Ohsaki does not limit those benefits to a cover of any particular shape. Instead, Ohsaki explains that "detecting element 2 is arranged on the user's wrist 4 so that the convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby it is prevented that the detecting element 2 slips off the detecting position of the user's wrist 4." Ex. 1009 ¶ 25; Ex. 1047 ¶ 10. Thus, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa's circular-shaped sensor, to improve adhesion as taught by Ohsaki. *See, e.g.*, Pet. 34–35. Nothing in Ohsaki's disclosure limits such a benefit to a specific shape of the convex surface. Ex. 1047 ¶¶ 10, 14, 16–21

Moreover, Ohsaki contrasts the ability to properly receive reflected light with a convex surface as compared to a flat surface and notes that,

> in the case that the translucent board 8 has a convex surface . . . the variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25; Ex. 1047 ¶ 11. Again, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa's sensor, to improve signal strength, as taught by Ohsaki. *See, e.g.*, Pet. 34–37. Again, nothing in Ohsaki's disclosure limits such a benefit to the shape of the convex surface. Ex. 1047 ¶¶ 10, 12, 13, 16–21.

Accordingly, we do not agree that Ohsaki's disclosed advantages attach only to a rectangular convex surface, or would have been inapplicable to the proposed combination of Aizawa and Ohsaki.[6]

We have considered Patent Owner's second argument, that Ohsaki's benefits are realized only when the sensor and convex surface are placed on the back of the user's wrist, which is the opposite side of the wrist taught by Aizawa. PO Resp. 30–39. We do not agree. As an initial matter, Petitioner does not propose bodily incorporating the references; Petitioner simply proposes adding a convex cover to Aizawa's sensor, without discussing where Aizawa's sensor is used. *See, e.g.*, Pet. 34. In other words, Petitioner's proposed modification does not dictate any particular placement, whether on the palm side or back side of the wrist.

To be sure, Ohsaki's Figures 3A–3B compare the performance of detecting element 2, including its translucent board 8 having a convex protrusion, and show better performance when the element is attached to the back side of the wrist versus the front side of the wrist, when the user is in motion. *See* Ex. 1009 ¶¶ 23–24, Figs. 3A–3B. However, we do not agree that these figures support Dr. Madisetti's conclusion that "Ohsaki indicates a convex surface only prevents slipping on the back (i.e., watch) side of the wrist in a specific orientation, but tends to slip when used in different locations or orientations" such as the palm side of the wrist—particularly in

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[6] Patent Owner also argues that, to the extent contended by Petitioner, it would not have been obvious to place a rectangular cover on top of Aizawa's sensor. PO Resp. 27–30. We do not understand Petitioner to have made any such contention and, accordingly, do not address this argument. *See, e.g.*, Pet. 37 (depicting Aizawa's circular sensor with an added convex cover).

comparison to a flat surface such as Aizawa's. Ex. 2004 ¶¶ 66, 75. Instead, Ohsaki acknowledges that, even when the detecting element is located "on the front [palm] side of the user's wrist 4, *the pulse wave can be detected well* if the user is at rest." Ex. 1009 ¶ 23 (emphasis added). Thus, Ohsaki discloses that, in at least some circumstances, a convex surface located on the front of the user's wrist achieves benefits. *Id.* Notably, the claims are not limited to detection during movement or exercise.

We credit, instead, Dr. Kenny's testimony that a person of ordinary skill in the art would have understood from Ohsaki that a convex protrusion will help prevent slippage, even in the context of Aizawa's sensor. *See* Ex. 1047 ¶¶ 15, 22–28. This is because the convex protrusion "promot[es] 'intimate contact with the surface of the user's skin,'" which "would have increased adhesion and reduced slippage of Aizawa's sensor when placed on the palm side of a user's wrist, with associated improvements in signal quality." *Id.* ¶¶ 27, 28 ("additional adhesive effect").

Dr. Madisetti testifies that "[b]ased on Aizawa's teaching that a flat acrylic plate improves adhesion on the palm side of the wrist, and Ohsaki's teaching that a convex surface tends to slip on the palm side of the wrist, a [person of ordinary skill in the art] would have come to the opposite conclusion from Dr. Kenny: that modifying Aizawa's flat adhesive plate 'to include a lens/protrusion . . . similar to Ohsaki's translucent board' would not 'improve adhesion.'" Ex. 2004 ¶ 84; *see also id.* ¶ 82. We disagree with this reading of Aizawa. It is true that Aizawa's plate 6 is illustrated as having a flat surface (Ex. 1006, Fig. 1(b)), and that Aizawa states the plate "improve[s] adhesion" (*id.* ¶ 13). Aizawa further states: "the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the

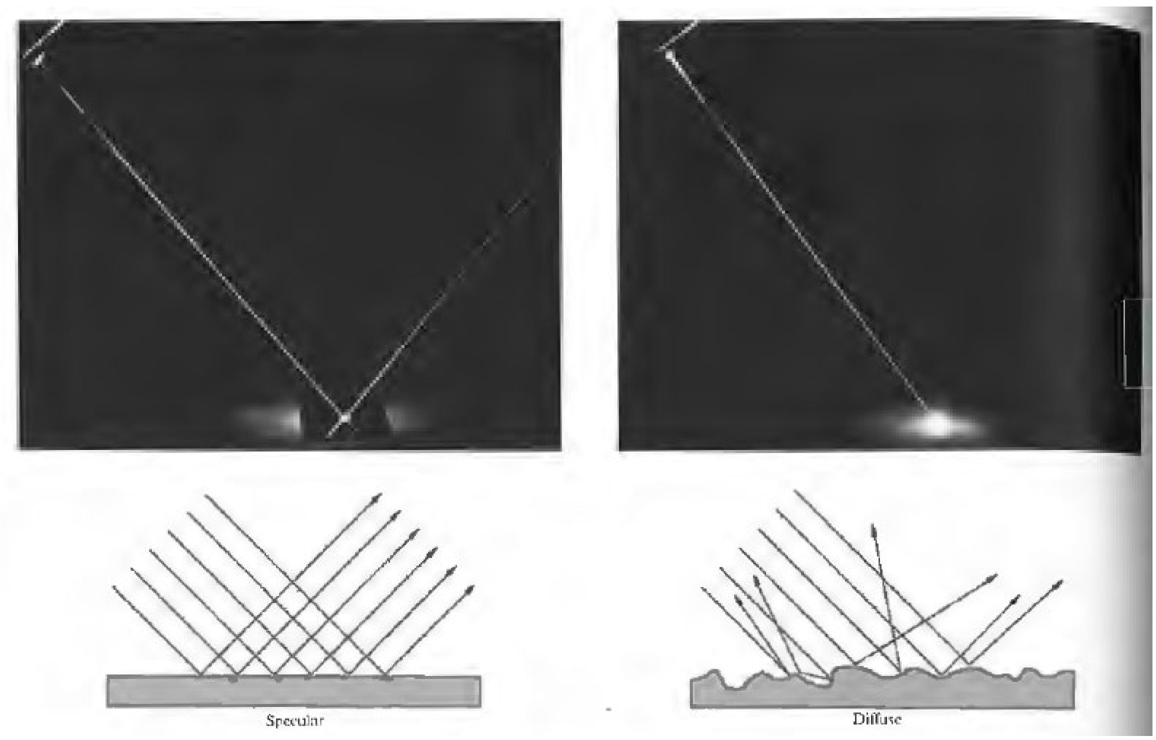
artery 11 of the wrist 10," and "[t]hereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶ 26. These disclosures, however, indicate the improved adhesion is provided by the acrylic material of plate 6, not the shape of the surface of the plate, which is never specifically addressed. *See also id.* ¶¶ 30, 34 ("Since the acrylic transparent plate 6 is provided . . . adhesion between the pulse rate detector 1 and the wrist 10 can be improved . . . ."). Aizawa does not associate this benefit of improved adhesion with the surface shape of the plate, but rather, with the existence of an acrylic plate to begin with. Thus, there is no teaching away from using a convex surface to improve the adhesion of Aizawa's detector to the user's wrist.

We have considered Patent Owner's third argument that a convex cover would condense light away from Aizawa's peripheral detectors, which Patent Owner alleges would decrease signal strength. PO Resp. 42–50. We disagree.

There appears to be no dispute that when emitted light passes through user tissue, the light diffuses and scatters as it travels. *See, e.g.*, Pet. Reply 22–26; Tr. 27:18–28:4 (Petitioner's counsel agreeing that "the incoming light from a detection standpoint is going to be coming from all sorts of different directions because of the randomness caused by the back scattering"), 65:23–66:16 (Patent Owner's counsel agreeing that light does not simply enter tissue and come back out "like it came out on a mirror"); Ex. 1041, 35:19–37:18 (Patent Owner's declarant describing light scattering as it travels through tissue, e.g., reflecting off blood, tissue, or other material); Ex. 1043, 28:2–10 (Patent Owner's declarant agreeing that reflecting light can be a signal for the '554 patent's sensor), 61:20–62:4

(explaining that "a light in this context, light emitted from the LEDs is diffused through the skin in that particular context, whatever that is"); Ex. 1047 ¶ 36.

The light thus travels at random angles and directions, and no longer travels in a collimated and perpendicular manner. Exhibit 1040,[7] Figure 4.12, illustrates the difference between diffuse and collimated light, and is reproduced below:



This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a photograph and an illustration of incoming collimated light reflecting from a rough surface. *See* Ex. 1040, 87–88 (original page numbers). The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. *See id.* The rough surface provides

[7] Eugene Hecht, *Optics* (2nd ed. 1990).

diffuse reflection, in which the reflected light rays travel in random directions. *See id.*; *see also* Ex. 1047 ¶ 36 ("A [person of ordinary skill in the art] would have understood that light that backscatters from the measurement site (after diffusing through tissue) reaches the active detection area from many random directions and angles.").

Dr. Kenny testifies that Aizawa "detect[s] light that has been 'partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector.'" Ex. 1047 ¶ 36 (quoting Ex. 1019, 36). Dr. Kenny further opines that a convex cover, when added to Aizawa's sensor with multiple detectors symmetrically arranged about a central light source, "allows light rays that otherwise would have missed the detection area to instead be directed toward that area as they pass through the interface provided by the cover," thus increasing the light-gathering ability of Aizawa's sensor. *Id.* ¶ 42; *see also id.* ¶ 46.

By contrast Dr. Madisetti testifies that "a convex surface condenses light passing through it towards the center of the sensor and away from the periphery." Ex. 2004 ¶ 86; *see also id.* ¶¶ 85, 89. We have considered this testimony, however, Dr. Madisetti's opinions largely are premised upon the behavior of collimated and perpendicular light as depicted in Figure 14B of the challenged patent. *See id.* ¶ 88. Dr. Madisetti does not explain how light would behave when approaching the sensor from various angles, as it would after being reflected by tissue. *Id.* ¶¶ 86–89; *see also id.* ¶¶ 90–97 (addressing motivation and also failing to discuss diffuse, scattered light). In other words, even if Patent Owner is correct that the '554 patent's Figure 14B depicts light condensing toward the center, this is not dispositive to the proposed modification, because light reflected by a user's tissue is

scattered and random, and is not collimated and perpendicular as shown in Figure 14B. Ex. 1001, Fig. 14B.

Patent Owner and Dr. Madisetti argue that "Petitioner and Dr. Kenny both [previously admitted] that a convex cover condenses light towards the center of the sensor and away from the periphery," in a different petition filed against a related patent, i.e., in IPR2020-01520. PO Resp. 43–45; Ex. 2004 ¶ 86. The cited portions of the Petition and Dr. Kenny's declaration from IPR2020-01520 discuss a decrease in the "mean path length" of a ray of light when it travels through a convex lens rather than through a flat surface. *See, e.g.*, Ex. 2020 ¶¶ 118–120. We do not agree that this discussion is inconsistent with Dr. Kenny's testimony here that, where light is reflected to the detectors at various random angles and directions, more light will reach Aizawa's symmetrically disposed detectors when travelling through the convex surface than would be reached without such a surface, because light that might have otherwise missed the detectors now will be captured. *See, e.g.*, Ex. 1047 ¶¶ 29–30, 36. We do not discern that the convergence of a single ray of light toward the center, as discussed in IPR2020-01520, speaks to the aggregate effect on *all* light that travels through the convex surface.

We additionally do not agree with Patent Owner's argument that Petitioner's Reply presents new arguments and evidence that should have been first presented in the Petition, to afford Patent Owner an adequate opportunity to respond. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, for the purpose of increasing the light gathering ability of Aizawa's device. *See* Pet. 34–38. The Patent Owner Response then challenged that contention, with several

arguments that Petitioner's proposed convex protrusion would not operate in the way the Petition alleges it would operate. *See* PO Resp. 42–50. This opened the door for Petitioner to provide, in the Reply, arguments and evidence attempting to rebut the contentions in the Patent Owner Response. *See* PTAB Consolidated Trial Practice Guide (Nov. 2019) ("Consolidated Guide"),[8] 73 ("A party also may submit rebuttal evidence in support of its reply."). This is what Petitioner did here. The Reply does not change Petitioner's theory for obviousness; rather, the Reply presents more argument and evidence in support of the same theory for obviousness presented in the Petition. *Compare* Pet. 34–38, *with* Reply 20–27.

Rationale 3

Petitioner further contends that a person of ordinary skill in the art would have recognized that a cover with a protruding convex surface, such as that taught by Ohsaki, would "protect the elements within the sensor housing" of Aizawa. Pet. 36–37. We are persuaded that adding a convex cover, such as that taught by Ohsaki, would also protect the sensor's internal components in a manner similar to Aizawa's flat acrylic plate. Ex. 1003 ¶ 97; *see also* Ex. 1008 ¶ 15 (noting that a cover "protect[s] the LED or PD").

We disagree with Patent Owner's fourth argument that a person of ordinary skill in the art would not have modified Aizawa as proposed because a convex cover would be prone to scratches and because other alternatives existed. Patent Owner's counsel did not dispute, during the oral hearing, that a convex cover would indeed serve to protect the internal

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[8] Available at https://www.uspto.gov/TrialPracticeGuideConsolidated.

sensor components in Aizawa, as Petitioner proposes. Tr. 64:6–65:5 (but noting that a flat cover would also protect and would be less prone to scratches). That a convex cover may be more prone to scratches than Aizawa's flat cover is one of numerous tradeoffs that a person of ordinary skill in the art would consider in determining whether the benefits of increased adhesion, signal strength, and protection outweigh the potential for a scratched cover. *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006). The record does not support that the possibility of scratches alone would have dissuaded a person of ordinary skill in the art from the proposed modification, to achieve the benefits identified by Petitioner.

For the foregoing reasons, we are persuaded by Petitioner's contentions.

vii. "[h] a handheld computing device in wireless communication with the physiological sensor device, wherein the handheld computing device comprises"

<u>Petitioner's Contentions</u>

Petitioner contends that the combination of, *inter alia*, Aizawa and Inokawa teaches a sensor device that is in wireless communication with a base device through its LEDs, wherein that base device is connected further to a PC. Pet. 27, 56–57; *see, e.g.*, Ex. 1006 ¶ 15 ("a transmitter for transmitting the measured pulse rate data to a display for displaying the pulse rate data"); Ex. 1008 ¶¶ 75 (explaining that sensed physiological information is transmitted from the sensor to the base device, when mounted, and further that "[t]he base device 17 . . . transmits this information to the PC 59"), 76, 77.

Petitioner also contends that Mendelson-2006 discloses a body-worn pulse oximetry system including a sensor module, a receiver module, and a PDA. Pet. 29, 58–59; *see, e.g.*, Ex. 1010, 1–2 (describing system), Fig. 1 (sensor attached to skin), Fig. 3 (PDA). Petitioner contends that signals acquired by the sensor are received and processed by the receiver module, and then wirelessly transmitted to the PDA. Pet. 30; Ex. 1010, 2. Petitioner contends that wireless transmission to a PDA, as discussed in Mendelson-2006, provides advantages such as offering "a low-cost touch screen interface," and "more effective medical care." Pet. 30–31; Ex. 1010, 3–4.

Petitioner contends that a person of ordinary skill in the art "would have also found it obvious to implement the physiological sensor device resulting from the combined teachings of Aizawa, Inokawa, and Ohsaki as part of a physiological measurement system including a handheld computing device, and to enable the physiological sensor device to communicate wirelessly with the handheld computing device," to obtain the advantages taught by Mendelson-2006. Pet. 28, 31–32, 33, 58; Ex. 1003 ¶¶ 80–83, 89–91; *see also* Pet. 43 n.4.

<u>Patent Owner's Arguments</u>

Patent Owner disputes Petitioner's contentions. Patent Owner argues that Petitioner's proposed combination is rooted in hindsight and results in a more complicated system. PO Resp. 59, 60. Specifically, Patent Owner characterizes Petitioner's combination as

> (1) eliminat[ing] Aizawa's existing transmitter so the resulting device will not require "a separate RF circuit"; (2) chang[ing] Aizawa's structure to add a second LED to transmit data using a base station, which would also require that a user remove the sensor before any data transfer can occur and thus eliminate the

> ability to display data in real-time; and then (3) add[ing] back in a separate communications circuit to the base station based on Mendelson 2006 so that the base station can send data to a PDA with a touch screen display.

Id. at 59–60 (citing, e.g., Ex. 2004 ¶ 114), 61. Patent Owner further argues that such a modification eliminates the desired real-time monitoring employed by Mendelson-2006. *Id.* (citing Ex. 2004 ¶¶ 113, 115).[9]

Analysis

As discussed above in Section II.D.5.iii, we determine that Petitioner demonstrated sufficiently that a person of ordinary skill in the art would have found it obvious to modify Aizawa to include an additional LED to, *inter alia*, allow for wireless transmission of sensed pulse rate and motion data to a base device. We further noted that although Aizawa discloses transmission of data for display (Ex. 1006 ¶¶ 15, 35), Aizawa is silent as to how the data is transmitted or displayed. In light of the combination with Inokawa, therefore, Aizawa's multiple LEDs would have allowed wireless transmission of data to a base device. *See, e.g.*, Ex. 1008 ¶ 76 ("[V]ital sign information stored in the memory 63, such as pulse and body motion, is transmitted to the base device 17 using the S-side infrared LED 23 of the pulse sensor 1 and the B-side PD 45 of the base device 17.").

Inokawa further discloses that the base device, once it receives information from the sensor, "transmits this information to the PC 59." *Id.* ¶ 75; *see also id.* ¶¶ 67, 77. As described by Dr. Kenny, "the physiological

[9] We do not address Patent Owner's argument that Mendelson-2006 does not disclose a "multi-emitter/multi-detector sensor" because Mendelson-2006 is not relied upon for such limitations. *See supra* § II.D.iii, iv.

sensor device's sensor component transmits physiological measurement data to an included base station via an optical communications interface, and the physiological sensor device's base station transmits signals responsive to a physiological parameter to a computer, via a network interface." Ex. 1003 ¶ 81.

With this backdrop, we are persuaded by Petitioner's contention that it would have been obvious to implement the physiological sensor device resulting from the combined teachings of Aizawa, Inokawa, and Ohsaki as part of a physiological measurement system that includes a handheld computing device. Indeed, Aizawa and Inokawa already teach the desirability of transmitting sensed data to, e.g., a computer or a display, although neither discloses further detail. *See, e.g.*, Ex. 1006, 15; Ex. 1008 ¶ 75; *see also* Ex. 1047 ¶ 56 (Aizawa is silent). In light of these teachings, we credit Dr. Kenny's testimony that transmitting sensed data wirelessly to a handheld computing device, as taught by Mendelson-2006, would have achieved the identified benefits of, e.g., providing a low-cost display with a simple user interface and easy activation of functions (Ex. 1003 ¶ 86) and the ability to provide more effective medical care when the handheld device is carried by first responders (*id.* ¶ 90). *See, e.g.*, *id.* ¶¶ 82–87, 91–93; Ex. 1047 ¶¶ 59–60. We are also persuaded that this would have been within the skill level of an ordinary artisan and would have achieved predictable results. *Id.* ¶ 92.

We do not agree with Patent Owner's characterization of the proposed combination. Petitioner does not propose "(1) eliminat[ing] Aizawa's existing transmitter . . . (2) chang[ing] Aizawa's structure to add a second LED to transmit data using a base station . . .; and then (3) add[ing] back in a

separate communications circuit to the base station." *Contra* PO Resp. 59–60; Ex. 1047 ¶ 58. As discussed above, Petitioner proposes that the system suggested by, *inter alia*, Aizawa and Inokawa—which includes a sensor in communication with a base device, and which contemplates additional communication from the base device to a PC—further includes a handheld computing device in wireless communication with that system. In other words, Petitioner's proposed combination effectively replaces or supplements Inokawa's PC 59 with a PDA, such as that taught by Mendelson-2006. Thus, in Petitioner's proposed combination, physiological data is sensed by Aizawa's sensor, transmitted to a base device through an additional LED, as taught by Inokawa, and further transmitted to, *inter alia*, a PDA, as taught by Mendelson-2006. *See, e.g.*, Pet. 27–34; *see also id.* at 43 n.4 (describing the proposed combination as, *inter alia*, adding "Inokawa's base station to Aizawa's physiological sensor device such that the sensor device includes a sensor and a base station with which the sensor communicates and through which the sensor communicates with a handheld device"). Indeed, both Aizawa and Inokawa expressly contemplate transmission to an additional computing device (*see, e.g.*, Ex. 1006, 15; Ex. 1008 ¶ 75); Petitioner's proposed modification merely states that such transmission occurs wirelessly to a handheld device. The record supports this contention.

We have considered Dr. Madisetti's testimony, but it is based on the same mischaracterization put forth by Patent Owner. Ex. 2004 ¶¶ 112 (mischaracterizing the combination), 114 (same). Notwithstanding this misrepresentation of the proposed modification, Dr. Madisetti does not dispute Dr. Kenny's testimony that wireless transmission to a handheld

computing device would have achieved the identified benefits, such as a low-cost device that improves medical care. *See id.* ¶¶ 112–118. As such, we credit Dr. Kenny's unrebutted testimony.

Patent Owner and Dr. Madisetti further criticize the combination, asserting that Mendelson-2006's wireless transmission exists to allow real-time monitoring, which is impossible where a sensor must be mounted on a base device to transfer information through LEDs. *Id.* ¶ 113; *see also* PO Resp. 59. However, as discussed in Section II.D.iii above, the lack of real-time measurement and transmission is simply one consideration among many. As noted in Inokawa, real-time wireless communication has its drawbacks. Ex. 1008 ¶ 5. We discern that a skilled artisan would have weighed these competing interests. "[A] given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine." *Medichem*, 437 F.3d at 1165 (citation omitted).

viii. "[i] one or more processors configured to wirelessly receive one or more signals from the physiological sensor device, the one or more signals responsive to at least a physiological parameter of the user"

The cited evidence supports Petitioner's contention that Mendelson-2006 describes wirelessly transmitting vital physiological information acquired from a sensor to a PDA, which receives it. Pet. 59–61; *see, e.g.*, Ex. 1010, 1, 2 ("The PDA can monitor multiple wearable pulse oximeters simultaneously and allows medics to collect vital physiological information to enhance their ability to extend more effective care to those with the most urgent needs."), 3 (explaining that the PDA "has sufficient computational resources for the intended application" and "can also serve to temporarily store vital medical information received from the wearable unit"), 3 ("The

[PDA's graphical user interface] also displays the subject's vital signs, activity level, body orientation, and a scrollable PPG waveform that is transmitted by the wearable device."), Fig. 3 (displaying SpO_2 and HR data); Ex. 1003 ¶¶ 179–180.

As discussed above, Petitioner's proposed combination involves transmission of sensed data from Aizawa's physiological sensor to a base device, as taught by Inokawa, and further wireless transmission of that data from the base device to a handheld computing device, such as a PDA. *See supra* §§ II.D.5.iii (transmission to base device accomplished with an additional LED, as taught by Inokawa), II.D.5.vii (further transmission from base device to, e.g., a PC and/or PDA, as taught by Mendelson-2006, and contemplated by Aizawa and Inokawa). In light of these teachings, we are persuaded by Petitioner's contention that a person of ordinary skill in the art "would have found it obvious to configure a processor of the PDA to wirelessly receive signals from the physiological sensor device" taught by the combination of, *inter alia*, Aizawa, Inokawa, and Mendelson-2006, wherein "the signals [are] responsive to physiological parameters of the user." Pet. 60–61; *see, e.g.*, Ex. 1003 ¶ 185.

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny. Ex. 1003 ¶¶ 181–186. Patent Owner does not present any argument against this limitation, apart from the arguments already addressed in Section II.D.5.vii.

ix. "[j]–[l] a touch-screen display configured to provide a user interface, wherein: the user interface is configured to display indicia responsive to measurements of the physiological parameter, and an orientation of the user interface is configurable responsive to a user input"

The cited evidence supports Petitioner's contention that Mendelson-2006 describes a PDA with a touchscreen display configured to display indicia responsive to measurements of, e.g., SpO_2 and HR. Pet. 61–62; *see, e.g.*, Ex. 1010, 3 ("The use of a PDA . . . also provides a low-cost touch screen interface.").

Petitioner acknowledges that "Mendelson-2006 does not explicitly state that an orientation of the GUI provided by the PDA is configurable responsive to a user input." Pet. 63. However, Petitioner contends that a person of ordinary skill in the art would have understood that "the LabVIEW software that was used 'to control all interactions between the PDA and the wearable unit via [t]he graphical user interface' included the option to configure an orientation of a user interface," e.g., by setting the report orientation to portrait or landscape view. *Id.* (alteration in original); *see, e.g.*, Ex. 1003 ¶¶ 191–192; Ex. 1027, 186 ("Set the report orientation—portrait or landscape.").

Petitioner further contends that, in light of these teachings, a person of ordinary skill in the art "would have found it obvious to make an orientation of the PDA's user interface configurable responsive to a user input, for the sake of user convenience." Pet. 64; *see, e.g.*, Ex. 1003 ¶ 193.

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 187–195. Patent Owner does not present any

argument against this limitation, apart from the arguments already addressed in Section II.D.5.vii.

x. "[m] a storage device configured to at least temporarily store at least the measurements of the physiological parameter."

The cited evidence supports Petitioner's contention that Mendelson-2006 teaches that the PDA is configured to store vital medical information received from the wearable pulse oximeter, and that an ordinarily skilled artisan "would have understood that the vital medical information would have included measurements of the physiological parameters obtained by the physiological sensor device (e.g., SpO_2 and HR)." Pet. 65; Ex. 1010, 3 ("The PDA can also serve to temporarily store vital medical information received from the wearable unit."); Ex. 1003 ¶ 198. Thus, Petitioner contends that a person of ordinary skill in the art "would have configured a storage device of the PDA to at least temporarily store measurements of physiological parameters (e.g., SpO_2 and HR)." Pet. 64–65; *see, e.g.*, Ex. 1003 ¶ 197.

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 196–199. Patent Owner does not present any argument against this limitation, apart from the arguments already addressed in Section II.D.5.vii.

xi. Reasonable Expectation of Success

Patent Owner argues that Petitioner has failed to demonstrate a reasonable expectation of success because Dr. Kenny did not perform a design analysis to create a functional sensor. PO Resp. 62–63. We disagree. As discussed in detail above, each of Petitioner's proposed modifications to

Aizawa—whether to include a second emitter, as taught by Inokawa; or to include a cover with a convex surface, as taught by Ohsaki; or to communicate with a handheld computing device, as taught by Mendelson-2006—is rooted in explicit teachings of the prior art, and is supported by persuasive declarant testimony.

We credit Dr. Kenny's testimony that, for each proposed modification, the combined prior art teachings would have been applied as known, to achieve predictable results. *See, e.g.*, Ex. 1003 ¶¶ 78 (applying Inokawa's teachings would have been "nothing more than improving Aizawa's pulse wave sensor that uses a single LED with the use of a known technique disclosed by Inokawa to detect and record body motion in addition to blood flow"), 160 (applying Ohsaki's teachings would have been "nothing more than adjusting transparent plate 6's shape to include a convex protrusion/lens surface similar to that disclosed by Ohsaki, and one of ordinary skill would have understood that this adjustment would improve adhesion to the user's skin and reduce variation in the signals detected by the sensor"), 178 ("applying Mendelson[-]2006's teachings . . . would have led to predictable results without altering or hindering the functions performed by the physiological sensor device. In fact, one of ordinary skill would have been motivated to implement the well-known technique of wirelessly transmitting data . . . to a handheld computing device"). For similar reasons discussed above with respect to each proposed modification, we conclude that that a skilled artisan would have had a reasonable expectation of success. *See supra* § II.D.5.iii, vi, vii–x; *see also* Ex. 1003 ¶¶ 71–199.

xii. Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

6. Independent Claim 20

Independent claim 20 consists of limitations that are substantially similar to elements [a]–[h] of claim 1. *Compare* Ex. 1001, 44:51–45:21, *with id.* at 46:31–52 (reciting that the "convex surface," as opposed to "the cover," is "sufficiently rigid"; omitting details of the "handheld computing device"). In asserting that claim 20 also would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006, Petitioner refers to the same arguments presented as to claim 1. *See* Pet. 76–78. Patent Owner relies on the same arguments discussed above regarding claim 1. PO Resp. 11–63.

For the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 20 would have been obvious over the cited combination of references. *See supra* § II.D.5.

7. Dependent Claim 28

Dependent claim 28 ultimately depends from independent claim 20 and further recites "the single protruding convex surface protrudes a height greater than 2 millimeters and less than 3 millimeters." Ex. 1001, 48:16–18.

Petitioner reiterates that the sensor rendered obvious by the combined teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006 would have included a cover with a single protruding convex surface, *see supra* § II.D.5.vi, and further contends that a person of ordinary skill in the art

"would have found it obvious that a device designed to fit on a user's wrist would be on the order of millimeters," consistent with Ohsaki's disclosure that the device is in "intimate contact" with the user's skin. Pet. 85–86 (citing, e.g., Ex. 1003 ¶ 275). Petitioner also contends that an ordinarily skilled artisan would have taken user comfort into account when establishing the dimensions of the device's convex cover. *Id.* at 86–87. With these considerations in mind, Petitioner contends that, "in order to provide a comfortable cover featuring a protruding convex surface that prevents slippage, the surface should protrude a height greater than 2 millimeters and less than 3 millimeters," because "there would have been a finite range of possible protruding heights, and it would have been obvious to select a protruding height that would have been comfortable to the user." *Id.* (citing, e.g., Ex. 1003 ¶¶ 273–277).

Patent Owner argues that none of the cited references disclose the claimed height range and that Petitioner relies on hindsight reconstruction. PO Resp. 64–66 (citing, e.g., Ex. 2004 ¶¶ 121–124). Patent Owner also characterizes Dr. Kenny's testimony as conclusory and unsupported. *Id.* at 66–67.

Petitioner is correct that, "[w]hen there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product . . . of ordinary skill and common sense." *KSR*, 550 U.S. at 398. Petitioner has shown sufficiently that only a finite number of solutions existed with respect to the height of a convex protrusion on a tissue-facing sensor, which would have met the art-recognized goals of both (1) intimate contact between the

sensor's surface and the user and (2) user comfort. *See, e.g.*, Ex. 1009 ¶¶ 6, 25. Bearing in mind these considerations, we credit Dr. Kenny's testimony that it would have been obvious, "in order to provide a comfortable cover featuring a protruding convex surface that prevents slippage, [that] the surface should protrude a height greater than 2 millimeters and less than 3 millimeters." Ex. 1003 ¶ 276.

We have considered Patent Owner's argument, and Dr. Madisetti's cited testimony. However, it is not dispositive that none of Aizawa, Inokawa, Ohsaki, or Mendelson-2006 teach the claimed range. PO Resp. 64–66; Ex. 2004 ¶¶ 105–107. Petitioner relies upon the knowledge, ability, and creativity of a person of ordinary skill in the art, not the teachings of a specific reference. Notably, Dr. Madisetti does not dispute Dr. Kenny's position that there were a finite number of options available for the height of the convex surface. Ex. 2004 ¶¶ 121–124. Therefore, we do not agree that Petitioner's contentions are rooted in impermissible hindsight. *See, e.g.*, *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971) ("Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made and does not include knowledge gleaned only from applicant's disclosure, such a reconstruction is proper.").

Accordingly, for the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 28 would have been obvious over the cited combination of references.

8. Dependent Claims 2–7 and 21–27

Petitioner also contends that claims 2–7 and 21–27 would have been obvious based on the same combination of prior art addressed above. These challenged claims all depend directly or indirectly from independent claim 1 or 20. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 65–75, 78–87. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 200–230, 245–277.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claims 1 and 20. PO Resp. 63–64 ("[T]he Petition fails to establish that independent claims 1 and 20 are obvious in view of the cited references of Ground 1 and therefore fails to establish obviousness of any of the challenged dependent claims."); *see supra* § II.D.5.

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–7 and 21–27 would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006, for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny.

9. Conclusion

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 1–7

and 20–28 would have been obvious over the cited combination of references.

E. Obviousness over the Combined Teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Bergey

Petitioner contends that claims 8–19 of the ’554 patent would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Bergey. Pet. 87–98; *see also* Pet. Reply 36–38. Patent Owner disagrees. PO Resp. 67–69; *see also* PO Sur-reply 27–29.

Based on our review of the parties’ arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of the evidence that claims 8–12 and 14–19 are unpatentable, but has not met its burden with respect to claim 13.

1. Overview of Bergey (Ex. 1016)

Bergey is a U.S. patent titled “Solid State Watch with Magnetic Setting,” and discloses a watch in which the electronics are “hermetically sealed in the watch case to be free of dust and moisture.” Ex. 1016, code (57). Moreover, the electronic components are “resiliently mounted for improved shock resistance.” *Id.*

2. Dependent Claims 8–10, 12, 14–16, 18, and 19

Petitioner contends that it would have been obvious to have modified the sensor of Aizawa-Inokawa-Ohsaki-Mendelson-2006 to hermetically seal the sensor components within the substrate, wall, and cover, so as to obtain advantages disclosed by Bergey, e.g., to protect the electronics and prevent condensation within the case. Pet. 88–89 (citing Ex. 1003 ¶¶ 278–281; Ex. 1016, code (57), 2:56–67, 8:48–9:34).

Petitioner identifies teachings in the prior art references that teach or suggest the limitations of each of dependent claims 8–10, 12, 14–16, 18, and 19, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 89–97. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 282–291, 294–298, 302–312, 315–316.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claims 1 and 20. PO Resp. 63–64 ("[T]he Petition fails to establish that independent claims 1 and 20 are obvious in view of the cited references of Ground 1 and therefore fails to establish obviousness of any of the challenged dependent claims."); *see supra* § II.D.5.

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 8–10, 12, 14–16, 18, and 19 would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Bergey for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny.

3. Dependent Claims 11 and 17

Dependent claim 11 ultimately depends from independent claim 1 and further recites "the single protruding convex surface protrudes a height between 1 millimeter and 3 millimeters." Ex. 1001, 45:65–67. Dependent claim 17 also ultimately depends from independent claim 1 and further recites "the single protruding convex surface protrudes a height greater than 2 millimeters and less than 3 millimeters." *Id.* at 46:23–25.

With respect to claims 11 and 17, both Petitioner and Patent Owner refer to their positions advanced with respect to claim 28, addressed in Section II.D.7 above. Pet. 91 (citing, e.g., Ex. 1003 ¶¶ 61–102, 273–277, 278–293), 96 (citing, e.g., Ex. 1003 ¶¶ 61–199, 273–277, 292–293, 313–314); PO Resp. 67–68, 69 (citing Ex. 2004 ¶¶ 126–129).

For the same reasons discussed above in Section II.D.7, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 11 and 17 would have been obvious over the cited combination of references.

4. Dependent Claim 13

Dependent claim 13 ultimately depends from independent claim 1 and further recites "the displayed indicia are further responsive to temperature." Ex. 1001, 46:4–6; *see also id.* 45:14–16 (claim 1 reciting, "the user interface is configured to display indicia responsive to measurements of the physiological parameter").

Petitioner contends that, as discussed above in Section II.D.5, the combined sensor "would have included a touch-screen display that provides a GUI including display indicia that are response [sic] to a user input." Pet. 92. Petitioner further contends,

> Consistent with Mendelson-2006's description of the PDA's "simple GUI" being configured to allow for "easy activation of various functions," a [person of ordinary skill in the art] would have found it obvious to make an orientation of the PDA's user interface configurable responsive to temperature, for the sake of user convenience. A POSITA would have understood that a display indicia that changes when the temperature reaches a threshold value is responsive to temperature. Thus, a POSITA would have found it obvious that a system resulting from the combination of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and

> Bergey would have allowed an orientation of the user interface to be further responsive to temperature.

Id. at 93 (citing Ex. 1003 ¶¶ 299–301; Ex. 1010, 3; Ex. 1020, 2, 6).

Patent Owner disputes Petitioner's contention, arguing that "Petitioner fails to identify any mention of temperature in Ohsaki, Aizawa, Inokawa, Mendelson 2006, or Bergey, let alone display indicia responsive to temperature." PO Resp. 68. Patent Owner also argues that the cited portion of Exhibit 1020 likewise fails to mention temperature, and while an uncited portion mentions "operating temperature" and "storage temperature," they are not relied upon or explained. *Id.*

On Reply, Petitioner contends that Dr. Kenny's cited testimony described the "LabView program, which includes a user interface configured to indicate when a temperature exceeds a threshold. . . . Thus, the Petition provides clear evidence that it was well known to display indicia that are responsive to temperature, and relates the same to Mendelson-2006's description of the PDA's user interface." Pet. Reply 37–38 (citing, *inter alia*, Ex. 1003 ¶ 300; Ex. 1027, 46; Ex. 1047 ¶¶ 66–67).

In its Sur-Reply, Patent Owner argues that reliance on the LabView manual provided as Exhibit 1027 is untimely, as it was not cited in the Petition or in Dr. Kenny's Declaration. PO Sur-reply 28–29. Moreover, Patent Owner argues that Petitioner still fails to explain why a person of ordinary skill in the art "would have added indicia responsive to ***temperature*** to Aizawa's ***pulse*** wave sensor based on LabVIEW's discussion of 'monitoring the temperature of an ***experiment***.'" *Id.* at 29 (citing Ex. 1027, 46). Further, Patent Owner argues that "Petitioner abandons its original argument" regarding the "***orientation*** of the user

interface" being "responsive to temperature," and now on Reply argues that it is the "***display indicia*** that are responsive to temperature." *Id.* (citing Pet. 93; Reply 37–38).

We agree with Patent Owner. The Petition contends it would have been obvious "to make an orientation of the PDA's user interface configurable responsive to temperature, for the sake of user convenience." However, none of the cited evidence supports this contention. Pet. 93; Ex. 1003 ¶¶ 299–301; Ex. 1010, 3; Ex. 1020, 2, 6.

Specifically, Dr. Kenny's declaration discusses the LabVIEW program and contends that it "included features that indicated 'when the temperature goes above a certain level,'" and concluded that "[o]ne of ordinary skill would have understood that a display indicia that changes when the temperature reaches a threshold value is responsive to temperature." Ex. 1003 ¶ 300. However, while the citation to Mendelson-2006 (Ex. 1010, 3) references LabVIEW, it does not discuss temperature, or display indicia responsive to temperature. Likewise, the cited portions of the HP iPAQ Specifications (Ex. 1020, 2, 6) also fail to discuss temperature or display indicia responsive to temperature. As such, Dr. Kenny's initial testimony lacks any supporting evidence.

On Reply, Petitioner cites a LabVIEW User Manual (Ex. 1027), which states that a warning light may activate to indicate when the temperature of an experiment exceeds a certain level. *Id.* at 46. We agree with Patent Owner that this evidence should have been cited in the Petition. As discussed above, the Petition lacks any supporting evidence to support the contention of obviousness. Petitioner cannot provide such evidence on Reply when it should have been offered in the Petition.

5. Conclusion

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 8–12 and 14–19 would have been obvious over the cited combination of references, but has not met its burden with respect to claim 13.

III. CONCLUSION

In summary:[10]

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–7, 20–28	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006	1–7, 20–28	
8–19	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006, Bergey	8–12, 14–19	13
Overall Outcome			1–12, 14–28	13

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–12 and 14–28 of the ’554 patent have been shown to be unpatentable;

[10] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

FURTHER ORDERED that claim 13 of the ’554 patent has not been shown to be unpatentable;

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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U.S. DEPARTMENT OF COMMERCE
UNITED STATES PATENT AND TRADEMARK OFFICE

May 23, 2022

THIS IS TO CERTIFY that the attached document is a list of the papers that comprise the record before the Patent Trial and Appeal Board (PTAB) for the *Inter Partes* Review proceeding identified below.

APPLE INC.,

Petitioner,

v.

MASIMO CORPORATION,

Patent Owner.

Case No.: IPR2020-01714
United States Patent No.: 10,631,765 B1

By authority of the
DIRECTOR OF THE UNITED STATES
PATENT AND TRADEMARK OFFICE

/s/ Mekbib Solomon
Certifying Officer

PROSECUTION HISTORY FOR *INTER PARTES* REVIEW NO.: IPR2020-01714

DATE	DESCRIPTION
09/30/2020	Petition for *Inter Partes* Review
09/30/2020	Petitioner's Power of Attorney
09/30/2020	Petitioner's Notice Ranking Petitions and Explaining Material Differences
10/15/2020	Notice of Filing Date Accorded
10/20/2020	Patent Owner's Mandatory Notices
01/08/2021	Petitioner's Updated Exhibit List
01/15/2021	Patent Owner's Notice of Waiver of Preliminary Response
04/13/2021	Decision - Institution of *Inter Partes* Review Proceeding
04/13/2021	Scheduling Order
04/27/2021	Patent Owner's Objections to Admissibility of Petitioner's Evidence Submitted Before Trial Institution
05/20/2021	Petitioner's Motion to File Supplemental Information
05/26/2021	Order Granting Petitioner's Motion to Submit Supplemental Information
06/01/2021	Petitioner's Submission of Supplemental Information
06/10/2021	Stipulation Modifying Due Dates
06/29/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
07/23/2021	Patent Owner's Response to Petition
07/23/2021	Patent Owner's Exhibit List
07/30/2021	Petitioner's Objections to Evidence
09/13/2021	Petitioner's Updated Mandatory Notice
10/29/2021	Petitioner's Reply to Patent Owner's Response
11/05/2021	Patent Owner's Objections to Admissibility of Evidence to Petitioner's Reply
11/17/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
12/03/2021	Petitioner's Oral Hearing Request
12/03/2021	Patent Owner's Request for Oral Argument
12/10/2021	Patent Owner's Sur-reply
12/10/2021	Patent Owner's Updated Exhibit List
12/17/2021	Order Setting Oral Argument
12/17/2021	Petitioner's Objections to Evidence
01/06/2022	Patent Owner's Mandatory Notice
01/14/2022	Patent Owner's Demonstratives for Trial Hearing
01/14/2022	Petitioner's Updated Exhibit List
02/16/2022	Oral Hearing Transcript
04/06/2022	Final Written Decision
04/12/2022	Notice of Appeal

Trials@uspto.gov
571-272-7822

Paper 34
Date: April 6, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

IPR2020-01714
Patent 10,631,765 B1

Before JOSIAH C. COCKS, ROBERT L. KINDER, and AMANDA F. WIEKER, *Administrative Patent Judges*.

WIEKER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

Apple Inc. ("Petitioner") filed a Petition requesting an *inter partes* review of claims 1–29 ("challenged claims") of U.S. Patent No. 10,631,765 B1 (Ex. 1001, "the '765 patent"). Paper 2 ("Pet."). Masimo Corporation ("Patent Owner") waived filing a preliminary response. Paper 7 ("PO Waiver"). We instituted an *inter partes* review of all challenged claims 1–29 on all grounds of unpatentability, pursuant to 35 U.S.C. § 314. Paper 8 ("Inst. Dec.").

After institution, Patent Owner filed a Response (Paper 16, "PO Resp.") to the Petition, Petitioner filed a Reply (Paper 20, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 25, "PO Sur-reply"). An oral hearing was held on January 19, 2022, and a transcript of the hearing is included in the record. Paper 33 ("Tr.").

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, Petitioner has met its burden of showing, by a preponderance of the evidence, that challenged claims 1–29 of the '765 patent are unpatentable.

B. Related Matters

The parties identify the following matters related to the '765 patent:

Masimo Corporation v. Apple Inc., Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

Apple Inc. v. Masimo Corporation, IPR2020-01715 (PTAB Sept. 30, 2020) (challenging claims 1–29 of the '765 patent);

Apple Inc. v. Masimo Corporation, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01713 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,624,564 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01716 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,702,194 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01722 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01723 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01733 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,195 B1); and

Apple Inc. v. Masimo Corporation, IPR2020-01737 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,709,366 B1).

Pet. 4–5; Paper 5, 1–4.

Patent Owner further identifies the following pending patent applications, among other issued and abandoned applications, that claim priority to, or share a priority claim with, the ’765 patent:

U.S. Patent Application No. 16/834,538;

U.S. Patent Application No. 16/449,143; and

U.S. Patent Application No. 16/805,605.

Paper 5, 1–2.

C. The ’765 Patent

The ’765 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on April 28, 2020, from U.S. Patent Application No. 16/725,478, filed December 23, 2019. Ex. 1001, codes (21), (22), (45), (54). The ’765 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The ’765 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:38–40. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:29–35, 64–65. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:45–48.

Figure 1 of the ’765 patent is reproduced below.

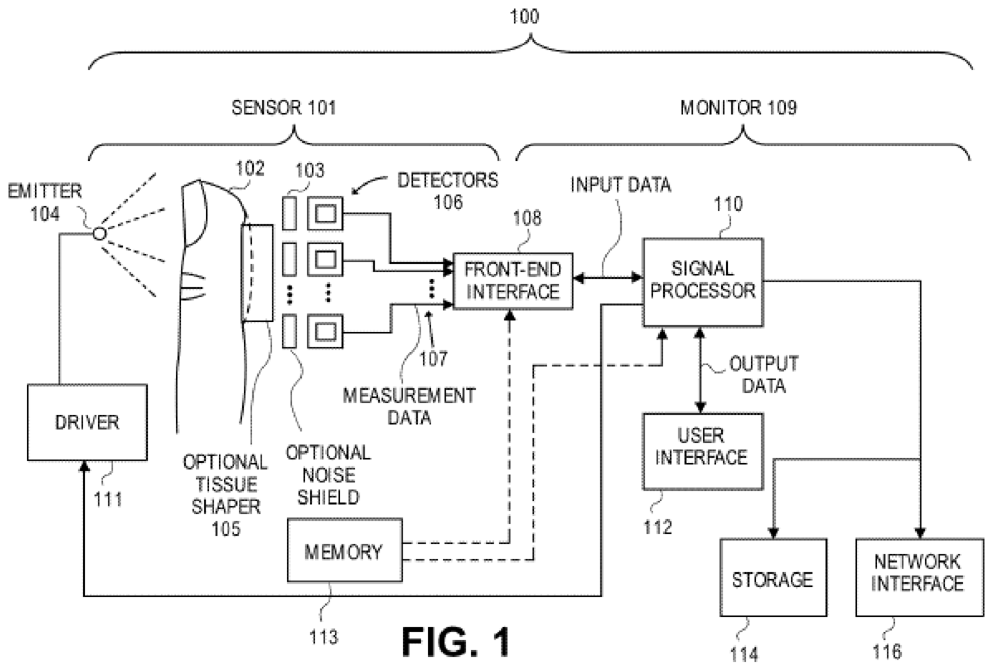

FIG. 1

Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:47–58. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* at 11:59–63. Emitters 104 emit light that is attenuated or reflected by the patient’s tissue at measurement site 102. *Id.* at 14:3–7. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light, detectors 106 output detector signals 107 to monitor 109 through front-end interface 108. *Id.* at 14:7–10, 26–32. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces the thickness of the patient’s measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 11:2–14.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:16–18. “[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals

received from the detectors." *Id.* at 15:21–24. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:46–56. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 15:60–16:11.

The '765 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate detector portions of sensor devices.

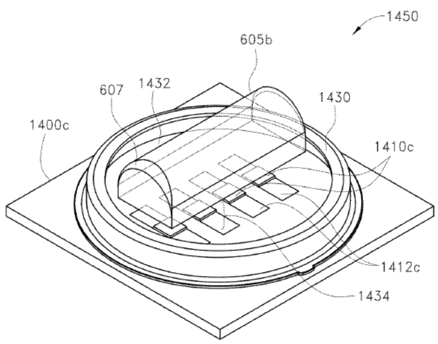

FIG. 14D

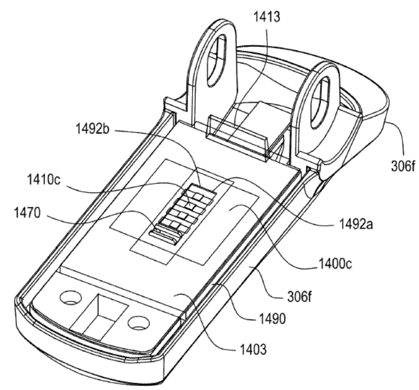

FIG. 14F

Figure 14D illustrates portions of a detector submount and Figure 14F illustrates portions of a detector shell. *Id.* at 6:44–47. As shown in Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 35:36–39, 36:30–37. Figure 14F illustrates a detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 37:9–17. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492a, respectively, placed above detectors 1410c. *Id.* Alternatively, cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:47–48.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.

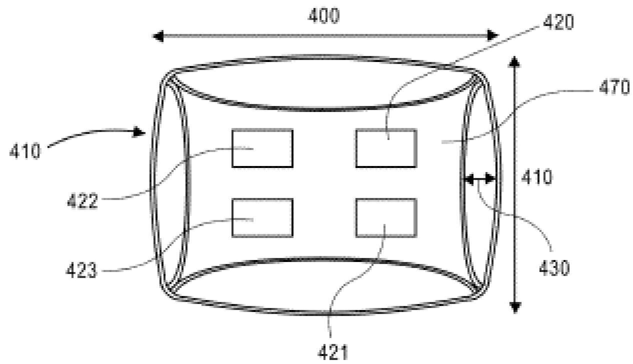

FIG. 4A

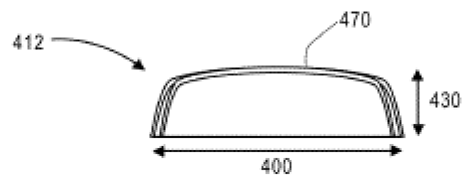

FIG. 4B

Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:18–24. "[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site." *Id.* "For example, . . . measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site." *Id.* at 23:39–43. The measurement site contact area may include windows 420–423 that "mimic or approximately mimic a configuration of, or even house, a plurality of detectors." *Id.* at 23:49–63.

D. Illustrative Claim

Of the challenged claims, claims 1 and 21 are independent. Claim 1 is illustrative and is reproduced below.

> 1. A physiological measurement system comprising:
>
> [a] a physiological sensor device comprising:
>
> > [b] one or more emitters configured to emit light into tissue of a user;
> >
> > [c] at least four detectors, wherein each of the at least four detectors has a corresponding window that allows light to pass through to the detector;

[d] a wall that surrounds at least the at least four detectors; and

[e] a cover comprising a protruding convex surface, wherein the protruding convex surface is above all of the at least four detectors, wherein at least a portion of the protruding convex surface is rigid, and wherein the cover operably connects to the wall; and

[f] a handheld computing device in wireless communication with the physiological sensor device, wherein the handheld computing device comprises:

[g] one or more processors configured to wirelessly receive one or more signals from the physiological sensor device, the one or more signals responsive to at least a physiological parameter of the user;

[h] a touch-screen display configured to provide a user interface, wherein:

[i] the user interface is configured to display indicia responsive to measurements of the physiological parameter, and

[j] an orientation of the user interface is configurable responsive to a user input; and

[k] a storage device configured to at least temporarily store at least the measurements of the physiological parameter.

Ex. 1001, 44:51–15 (bracketed identifiers a–k added). Independent claim 21 includes limitations substantially similar to limitations [a]–[f] of claim 1. *Id.* at 46:31–49.

E. Applied References

Petitioner relies upon the following references:

Bergey, U.S. Patent No. 3,789,601, filed July 15, 1971, issued February 5, 1974 (Ex. 1016, "Bergey);

Mendelson, U.S. Patent No. 6,801,799 B2, filed February 6, 2003, issued October 5, 2004 (Ex. 1012, "Mendelson-799");

Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1009, "Ohsaki");

Aizawa, U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002 (Ex. 1006, "Aizawa");

Schulz et al., U.S. Patent Application Publication No. 2004/0054291 A1, filed July 31, 2003, published March 18, 2004 (Ex. 1013, "Schulz");

Goldsmith et al., U.S. Patent Application Publication No. 2007/0093786 A1, filed July 31, 2006, published April 26, 2007 (Ex. 1011, "Goldsmith"); and

Y. Mendelson et al., "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," Proceedings of the 28th IEEE EMBS Annual International Conference, 912–915 (2006) (Ex. 1010, "Mendelson-2006").

Pet. 11.

Petitioner also submits, *inter alia*, the Declaration of Thomas W. Kenny, Ph.D. (Ex. 1003), and the Second Declaration of Thomas W. Kenny (Ex. 1047). Patent Owner submits, *inter alia*, the Declaration of Vijay K. Madisetti, Ph.D. (Ex. 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madisetti, including from this proceeding and others. *See* Exs. 1052–1054, 2006–2009, 2027.

F. Asserted Grounds of Unpatentability

We instituted an *inter partes* review based on the following grounds. Inst. Dec. 10, 34.

Claim(s) Challenged	35 U.S.C. §	References/Basis
1–8, 10–13, 15–16, 20–29	103	Mendelson-799, Ohsaki, Schulz, Mendelson-2006
9	103	Mendelson-799, Ohsaki, Schulz, Mendelson-2006, Bergey
14	103	Mendelson-799, Ohsaki, Schulz, Mendelson-2006, Goldsmith
17–19	103	Mendelson-799, Ohsaki, Schulz, Mendelson-2006, Aizawa

II. DISCUSSION

A. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2019). Petitioner submits that no claim term requires express construction. Pet. 9–10. Patent Owner submits that claim terms should be given their ordinary and customary meaning, consistent with the Specification. PO Resp. 10–11.

We agree that no claim terms require express construction. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

B. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103(a) if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness.[1] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must support its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

[1] Patent Owner has not presented objective evidence of non-obviousness.

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

Petitioner identifies the appropriate level of skill in the art as that possessed by a person with "a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information." Pet. 9 (citing Ex. 1003 ¶¶ 20–21). "Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline." *Id.*

Patent Owner makes several observations regarding Petitioner's identified level of skill in the art but, "[f]or this proceeding, [Patent Owner] nonetheless applies Petitioner's asserted level of skill." PO Resp. 10 (citing Ex. 2004 ¶¶ 32–35).

We adopt Petitioner's assessment as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

D. Obviousness over the Combined Teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006

Petitioner contends that claims 1–8, 10–13, 15, 16, and 20–29 of the '765 patent would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006. Pet. 11–87; *see also generally* Pet. Reply. Patent Owner disagrees. PO Resp. 12–62; *see also generally* PO Sur-reply.

Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a

preponderance of evidence that claims 1–8, 10–13, 15, 16, and 20–29 are unpatentable.

1. Overview of Mendelson-799 (Ex. 1012)

Mendelson-799 is a U.S. patent titled "Pulse Oximeter and Method of Operation," and discloses a sensor for non-invasive measurement of a blood parameter, which includes a sensor housing, a radiation source, and a detector. Ex. 1012, codes (54), (57).

Figure 7 of Mendelson-799 is reproduced below.

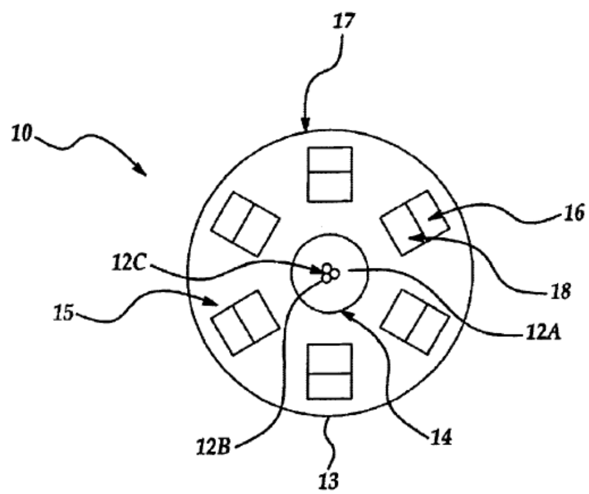

Figure 7

Figure 7 illustrates optical sensor 10 with light source 12, which includes three closely spaced light emitting elements 12a, 12b, 12c. *Id.* at 9:22–28. Optical sensor 10 includes an array of discrete detectors, i.e., "far" detectors 16 and "near" detectors 18, "arranged in two concentric ring-like arrangements . . . surrounding the light emitting elements." *Id.* at 9:29–34. "[L]ight shield 14 is positioned between the photodiodes and the light emitting elements, and prevents direct optical coupling between them, thereby maximizing the fraction of backscattered light passing through the arterially perfused vascular tissue in the detected light." *Id.* at 9:35–40.

Sensor housing 17 accommodates the light source, light shield, and detectors. *Id.* at 9:34–35.

Figure 8 of Mendelson-799 is reproduced below.

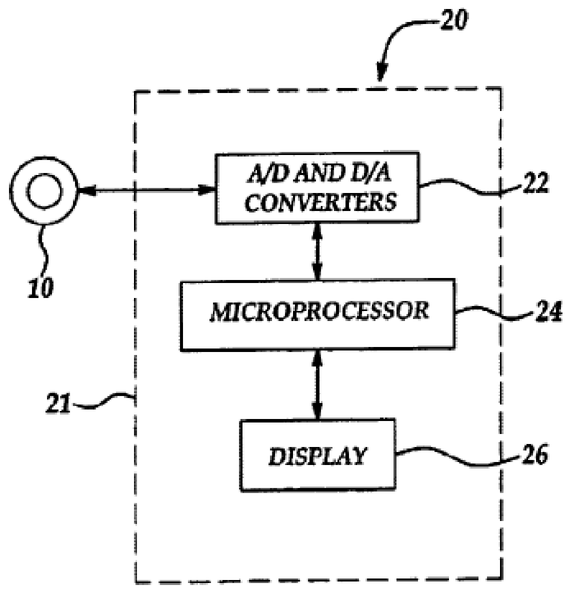

Figure 8

Figure 8 illustrates a block diagram of pulse oximeter 20 using sensor 10. *Id.* at 10:16–17. Pulse oximeter 20 includes control unit 21, with electronic block 22 connectable to sensor 10, microprocessor 24, and display 26, which presents measurement results. *Id.* at 10:17–22. "The measured data (i.e., electrical output of the sensor 10 indicative of the detected light) is directly processed in the block 22, and the converted signal 25 is further processed by the microprocessor 24." *Id.* at 10:22–25.

2. Overview of Ohsaki (Ex. 1009)

Ohsaki is a U.S. patent application publication titled "Wristwatch-type Human Pulse Wave Sensor Attached on Back Side of User's Wrist," and discloses an optical sensor for detecting a pulse wave of a human body. Ex. 1009, code (54), ¶ 3.

Figure 1 of Ohsaki is reproduced below.

FIG. 1

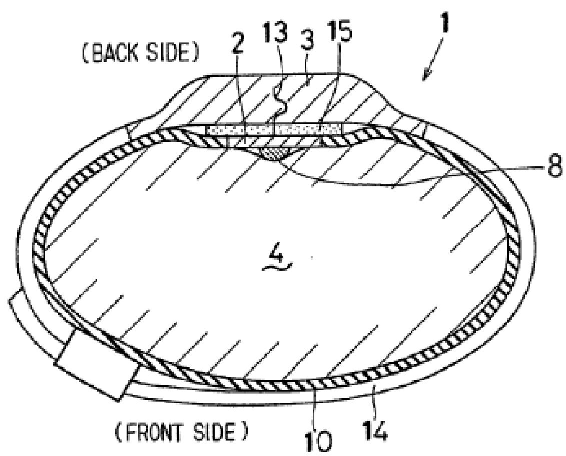

Figure 1 illustrates a cross-sectional view of pulse wave sensor 1 attached on the back side of user's wrist 4. *Id.* ¶¶ 12, 16. Pulse wave sensor 1 includes detecting element 2 and sensor body 3. *Id.* ¶ 16.

Figure 2 of Ohsaki, reproduced below, illustrates further detail of detecting element 2.

FIG. 2

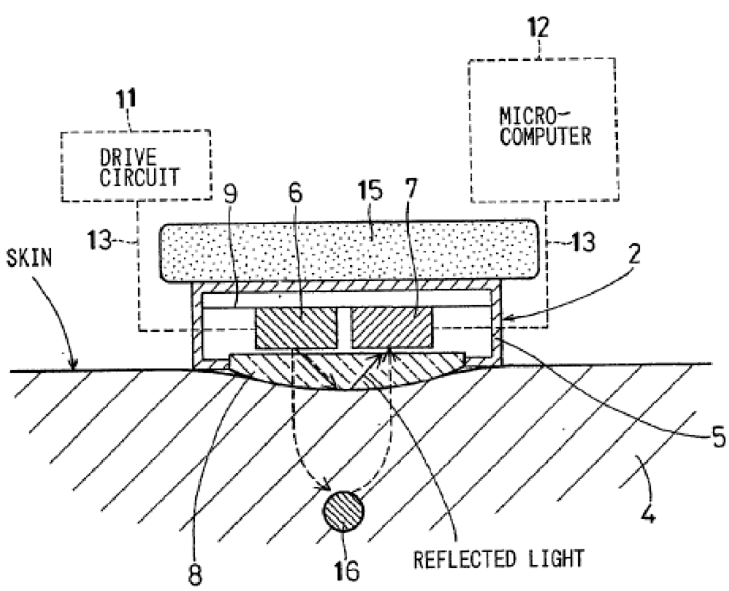

Figure 2 illustrates a mechanism for detecting a pulse wave. *Id.* ¶ 13. Detecting element 2 includes package 5, light emitting element 6, light receiving element 7, and translucent board 8. *Id.* ¶ 17. Light emitting element 6 and light receiving element 7 are arranged on circuit board 9 inside package 5. *Id.* ¶¶ 17, 19.

"[T]ranslucent board 8 is a glass board which is transparent to light, and attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8." *Id.* ¶ 17. "[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin," preventing detecting element 2 from slipping off the detecting position of the user's wrist. *Id.* ¶ 25. By preventing the detecting element from moving, the convex surface suppresses "variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin." *Id.* Additionally, the convex surface prevents penetration by "noise such as disturbance light from the outside." *Id.*

Sensor body 3 is connected to detecting element 2 by signal line 13. *Id.* ¶ 20. Signal line 13 connects detecting element 2 to drive circuit 11, microcomputer 12, and a monitor display (not shown). *Id.* Drive circuit 11 drives light emitting element 6 to emit light toward wrist 4. *Id.* Detecting element 2 receives reflected light which is used by microcomputer 12 to calculate pulse rate. *Id.* "The monitor display shows the calculated pulse rate." *Id.*

3. Overview of Schulz (Ex. 1013)

Schulz is a U.S. patent application publication titled "Pulse Oximetry Ear Sensor," and discloses an ear sensor assembly including an emitter pad and a detector pad. Ex. 1013, codes (54), (57).

Figure 19C of Schulz is reproduced below.

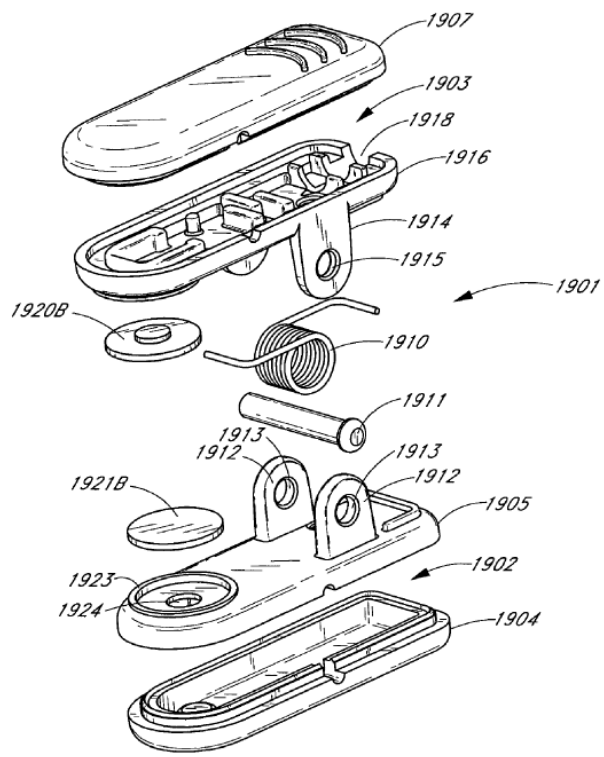

Figure 19C illustrates an exploded top perspective view of an ear sensor clip. *Id.* ¶ 31. Each sensor clip 1900 includes "opposingly positioned housings 1902 and 1903 that house one or more sensor optical components." *Id.* ¶ 65. Each housing includes respective inward facing shells 1905 and 1906.[2] *Id.* ¶ 65. "[I]nward facing shells 1905 and 1906 further include windows 1919 and 1924 that provide an aperture for transmission of optical

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[2] Figure 19C appears to label inward facing shell 1906 as 1916. *See id.* at Fig. 19B.

energy to or from a tissue site. Translucent silicone material covers windows 1919 and 1924 providing lenses 1920 and 1921." *Id.* ¶ 67. A "thin sheet of opaque material is located beneath window 1919 or 1924, and a window in the opaque material provides an aperture for transmission of optical energy to or from the tissue site." *Id.* ¶ 73. "The opaque material blocks light, and the window in the opaque material can be sized as needed to block the proper amount of light from entering the aperture to, for example, avoid saturation of the light detector." *Id.*

4. Mendelson-2006 (Ex. 1010)

Mendelson-2006 is a journal article titled "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," and discloses a wireless wearable pulse oximeter connected to a personal digital assistant ("PDA"). Ex. 1010, 1.[3]

Figure 1 of Mendelson-2006 is reproduced below.

[3] Petitioner cites to the page numbers added to Exhibit 1010, rather than the native page numbering that accompanies the article. *See, e.g.*, Pet. 23–25. We follow Petitioner's numbering scheme.

Figure 1 illustrates a sensor module attached to the skin (top), and a photograph of a disassembled sensor module and receiver module (bottom). The sensor module includes an optical transducer, a stack of round printed circuit boards, and a coin cell battery. *Id.* at 2.

Figure 2 of Mendelson-2006 is reproduced below.

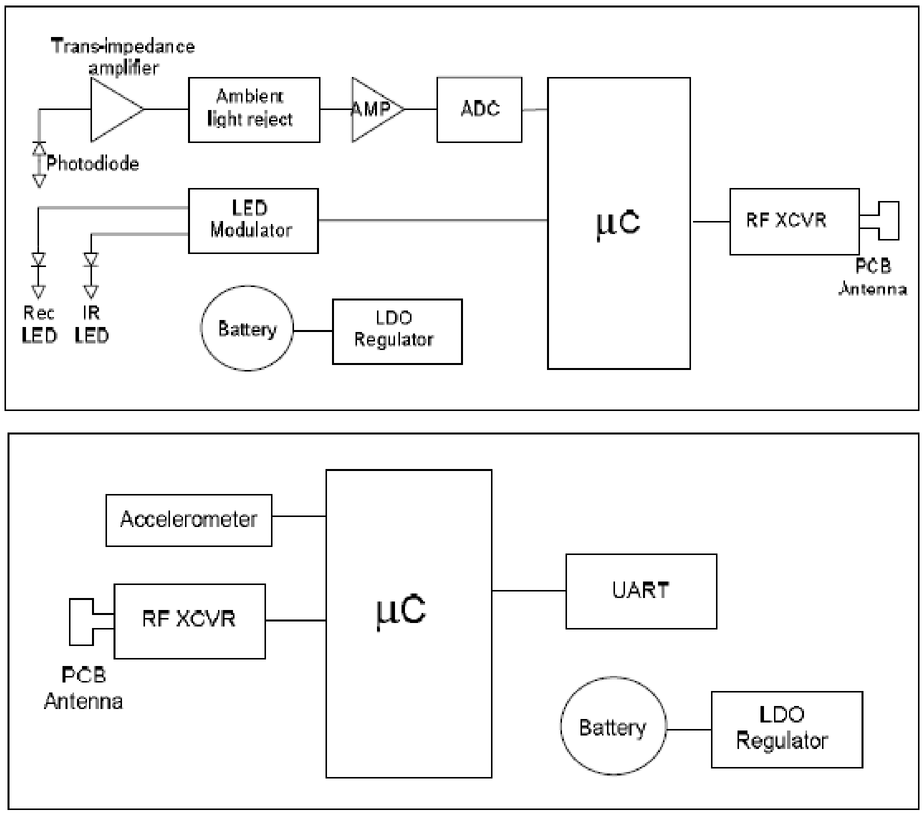


Figure 2 depicts a system block diagram of the wearable, wireless, pulse oximeter including the sensor module (top) and the receiver module (bottom). *Id.* The sensor module includes at least one light-emitting diode ("LED"), a photodetector, signal processing circuitry, an embedded microcontroller, and an RF transceiver. *Id.* at 1–2. Mendelson-2006 discloses that a concentric array of discrete photodetectors could be used to increase the amount of backscattered light detected by a reflectance type pulse oximeter sensor. *Id.* at 4. The receiver module includes an embedded

microcontroller, an RF transceiver for communicating with the sensor module, and a wireless module for communicating with the PDA. *Id.* at 2.

As a PDA for use with the system, Mendelson-2006 discloses "the HP iPAQ h4150 PDA because it can support both 802.11b and Bluetooth™ wireless communication" and "has sufficient computational resources." *Id.* at 3. Mendelson-2006 further discloses that

> [t]he use of a PDA as a local terminal also provides a low-cost touch screen interface. The user-friendly touch screen of the PDA offers additional flexibility. It enables multiple controls to occupy the same physical space and the controls appear only when needed. Additionally, a touch screen reduces development cost and time, because no external hardware is required. . . . The PDA can also serve to temporarily store vital medical information received from the wearable unit.

Id.

The PDA is shown in Figure 3 of Mendelson-2006, reproduced below.

Figure 3 illustrates a sample PDA and its graphical user interface ("GUI"). *Id.* Mendelson-2006 explains that the GUI allows the user to interact with the wearable system. *Id.* "The GUI was configured to present the input and output information to the user and allows easy activation of various functions." *Id.* "The GUI also displays the subject's vital signs, activity

level, body orientation, and a scrollable PPG waveform that is transmitted by the wearable device." *Id.* For example, the GUI displays numerical oxygen saturation ("SpO_2") and heart rate ("HR") values. *Id.*

5. Independent Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006. Pet. 11–61. Below, we set forth how the combination of prior art references teaches or suggests the claim limitations that are not disputed by the parties. For those limitations and reasons for combining the references that are disputed, we examine each of the parties' contentions and then provide our analysis.

i. "A physiological measurement system comprising"

The cited evidence supports Petitioner's undisputed contention that the combination of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006 satisfies the subject matter of the preamble.[4] Pet. 40–42; *see, e.g.*, Ex. 1012, code (57), 8:37–41, 9:22–40, 10:15–22, Fig. 7 (sensor device), 8 (pulse oximeter); Ex. 1010, 1–4, Fig. 3 (handheld computing device); Ex. 1003 ¶¶ 89–118, 121–122.

ii. "[a] a physiological sensor device comprising"

The cited evidence supports Petitioner's undisputed contention that Mendelson-799 discloses a physiological sensor device including sensor 10 and pulse oximeter 20. Pet. 42; *see, e.g.*, Ex. 1012, code (57) ("A sensor for

[4] Whether the preamble is limiting need not be resolved because Petitioner shows sufficiently that the preamble's subject matter is satisfied by the art.

use in an optical measurement device."), 9:22–40 (describing sensor 10), 10:16–30 (describing pulse oximeter 20, including sensor 10), Figs. 7–8.

iii. "[b] one or more emitters configured to emit light into tissue of a user"

The cited evidence supports Petitioner's undisputed contention that Mendelson-799 discloses one or more light emitting elements 12a–c that emit light into a user's tissue. Pet. 43–44; *see, e.g.*, Ex. 1012, 9:22–40 ("The sensor 10 comprises . . . light source 12 composed of three closely spaced light emitting elements (e.g., LEDs or laser sources) 12a, 12b and 12c generating light of three different wavelengths."), Fig. 7.

iv. "[c] at least four detectors,
wherein each of the at least four detectors has a corresponding window that allows light to pass through to the detector"

<u>Petitioner's Undisputed Contentions</u>

Petitioner contends that Mendelson-799 discloses twelve photodetectors located within a sensor housing. Pet. 44–45. Patent Owner does not dispute this contention, and we agree with Petitioner. Mendelson-799 discloses that "sensor 10 comprises . . . an array of discrete detectors (e.g., photodiodes)," including six far detectors 16 and six near detectors 18. *See, e.g.*, Ex. 1012, 9:22–40, Fig. 7.

Petitioner does not contend that Mendelson-799 discloses the claimed windows. Rather, Petitioner contends that Schulz teaches "a sensor featuring 'a thin sheet of opaque material' placed inside the sensor's housing . . . with 'a window in the opaque material provid[ing] an aperture for transmission of optical energy to or from the tissue site,'" wherein the opaque material blocks light and avoids saturation of the sensor's detectors.

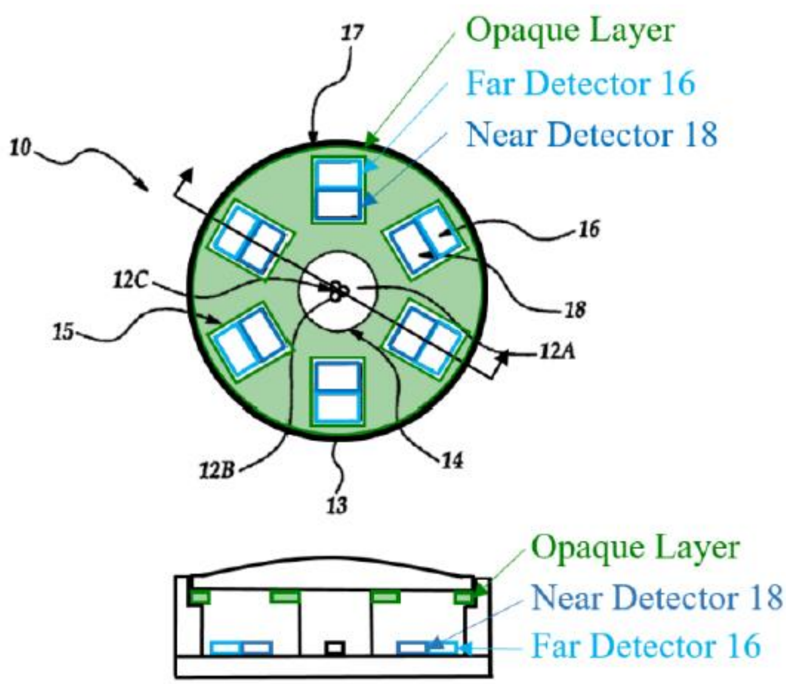
Pet. 30. Patent Owner does not dispute this contention, and we agree with Petitioner. Schulz discloses that a "thin sheet of opaque material" can be placed between the optical components of the sensor and the sensor's housing. Ex. 1013 ¶ 73. Schulz explains that the opaque material includes a window that allows for transmission of optical energy to the detector. *Id.* According to Schulz, the "opaque material blocks light, and the window in the opaque material can be sized as needed to block the proper amount of light from entering the aperture to, for example, avoid saturation of the light detector." *Id.*

<u>Petitioner's Disputed Contentions</u>

Petitioner further contends that a person of ordinary skill in the art would have been motivated "to add a layer of opaque material" to Mendelson-799's sensor, as taught by Schulz, "and to size windows in the opaque material as appropriate to avoid saturation of each of the sensor's detectors." Pet. 30 (citing, e.g., Ex. 1003 ¶¶ 103–109), 45–46 (citing, e.g., Ex. 1003 ¶¶ 89–109). According to Petitioner, errors are reduced by minimizing the amount of ambient light that reaches the detectors, for example, by decreasing the angle of incidence to the detectors. *Id.* at 31 (citing Ex. 1019, 76, 79–80, 94). Petitioner contends that a person of ordinary skill in the art would have understood that "Schulz's opaque layer limits errors by decreasing the angle of incidence to the photodiode to that enabled by the window included within the layer, and by otherwise preventing ambient light from reaching the photodiode." *Id.* (citing, e.g., Ex. 1003 ¶¶ 104–105). Petitioner also contends that a skilled artisan would have recognized that, when applying Schulz's teachings to a sensor with

multiple detectors, multiple windows would have been employed. *Id.* at 31–32 (citing, e.g., Ex. 1003 ¶¶ 106–109).

To illustrate its proposed modification, Petitioner includes an annotated and modified view of Mendelson-799's Figure 7, as well as an added sectional view, both of which are reproduced below. Pet. 34; *see also id.* at 46 (similar figures with slightly different annotations); Ex. 1003 ¶¶ 108–109.



Petitioner's modified figure and added sectional view depict the sensor of Mendelson-799 with an added opaque layer (illustrated in green) having windows, as Petitioner contends would have been rendered obvious by Schulz.[5] Pet. 34, 46.

[5] Petitioner's annotated figures also include an added opaque wall and an added top cover as discussed *infra* at Sections II.D.5.v and II.D.5.vi.

Patent Owner's Arguments

Patent Owner argues that a person of ordinary skill in the art would not have been motivated to modify Mendelson-799 as proposed because adding an opaque layer would *decrease* signal strength, especially for a reflectance pulse oximeter like Mendelson-799, which Patent Owner alleges has a weak signal already. PO Resp. 47–48 (citing, e.g., Ex. 2004 ¶¶ 83–84); PO Sur-reply 22–24. According to Patent Owner, Schulz uses the window in the opaque material only to reduce "desired" light to a "proper" level, i.e., only to reduce the light generated by the emitter that passes through the user's tissue before reaching the detector, but the window in the opaque material does not reduce *ambient* light. PO Resp. 50 ("Schulz uses a separate cover—not the window [in the opaque material]—to block ambient light.") (citing Ex. 1013 ¶ 41); PO Sur-reply 22–23 (citing, e.g., Ex. 2004 ¶¶ 83–88). Thus, according to Patent Owner, use of a windowed opaque material in Mendelson-799's sensor would make its weak signal even weaker by limiting the light from the emitter. PO Sur-reply 24. Patent Owner argues that decreasing signal strength in this way would have been inconsistent with Petitioner's additional modification to add a convex cover to the sensor of Mendelson-799, to *increase* signal strength. PO Resp. 47–48; PO Sur-reply 26; *see infra* § II.D.5.vi.

Moreover, Patent Owner argues that the motivation put forth by Petitioner—to avoid saturation—is not shown to have been a problem for the sensor of Mendelson-799. PO Resp. 47. Patent Owner also argues that there were "easier approaches for addressing saturation of the detectors," such as "adjusting gain or LED brightness." *Id.* at 48.

Patent Owner also argues aspects of Schulz individually. For example, Patent Owner argues that Schulz is directed to an ear sensor, and that there are physiological differences in measurement locations that are not accounted for by Petitioner. PO Resp. 48–49 (citing, e.g., Ex. 2004 ¶ 85). Additionally, Patent Owner argues that Schulz discloses only a single window, not multiple windows as claimed. *Id.* at 49; PO Sur-reply 26–27.

Finally, Patent Owner criticizes Petitioner's reliance on additional evidence that does not form part of the asserted ground. *Id.* at 51 (citing, e.g., Ex. 1019; Ex. 1023; Ex. 2004 ¶¶ 89–92).

<u>Analysis</u>

We have considered the parties' arguments and cited evidence, and we are persuaded by Petitioner's contentions. As discussed above, Schulz explicitly teaches that its opaque material and window "blocks light" and "avoid[s] saturation of the light detector." Ex. 1013 ¶ 73. Petitioner cites persuasive and well-supported evidence, including the testimony of its declarant, that a person of ordinary skill in the art would have been motivated to add such an arrangement to the sensor of Mendelson-799 to achieve this same disclosed benefit, i.e., to avoid saturation of Mendelson-799's detectors. *See, e.g.*, Ex. 1003 ¶¶ 101–109. For example, Dr. Kenny's testimony regarding the ability of an opaque material with windows to avoid saturation is supported by Schulz and by the Webster textbook, which discusses the importance of minimizing "light other than the optical signals of interest." *Id.* ¶ 104 (citing Ex. 1019, 76). We are persuaded by Petitioner's contentions and Dr. Kenny's testimony.

We do not agree with Patent Owner's argument that this modification would *decrease* signal strength. PO Resp. 47–48. We discern that

Petitioner's proposed modification would not alter the signal of interest, i.e., the optical signal that passes from the emitter, through the user's tissue, and to the photodetectors. Rather, the cited evidence supports Petitioner's contention that the proposed modification would have blocked light *other than* that from the signal of interest, i.e., that the modification would have block light *other than* that from the emitter. *See, e.g.*, Ex. 1003 ¶ 108 ("Schulz would have motivated one of ordinary skill to modify the sensor . . . to further include an opaque layer that would have *blocked light other than at windows corresponding to the sensor's photodiodes*.") (emphasis added); Ex. 1013 ¶ 73 ("The opaque material blocks light, and the window in the opaque material can be sized as needed to block the proper amount of light from entering the aperture to, for example, avoid saturation of the light detector."); *see also* Pet. Reply 22–23 ("By blocking noise while allowing signal to reach the detectors, the features of Schulz lead to increased signal-to-noise ratio at the detectors, rather than leading to a 'weaker signal' as Masimo alleges."). Thus, we do not agree that the proposed modification would have decreased signal strength.

We have considered Patent Owner's argument that Schulz uses the opaque material to reduce only "desired" light to a "proper" level, i.e., to reduce light from the emitter that passes through the user's tissue, to avoid saturation. PO Resp. 50; PO Sur-reply 22–23 (citing, e.g., Ex. 2004 ¶¶ 83–88). We do not find any support for this argument in Schulz. To the contrary, Schulz explains that "the window in the opaque material can be sized as needed to block the proper amount of light from entering the aperture to, for example, avoid saturation of the light detector." Ex. 1013 ¶ 73. Contrary to Patent Owner's argument, Schulz simply states that its

window is sized to control the amount of light *that enters the aperture*; Schulz does not state where that light comes from, or that it only controls against light from the emitter. Patent Owner identifies no basis in Schulz's disclosure to conclude that Schulz's emitter operates at a level that would saturate the detector, absent the addition of an opaque material. Likewise, we do not find any support for this argument in the cited portions of Dr. Madisetti's declaration. *See, e.g.*, Ex. 2004 ¶ 88 (concluding, without persuasive explanation, that Schulz's window blocks light only from the emitter, not ambient light).

We also do not agree with Patent Owner's argument that Petitioner has not shown that saturation was a problem for Mendelson-799's sensor. PO Resp. 47. Mendelson-799 need not identify a problem with saturation in order to be improved by the proposed modification. Indeed, Petitioner "does not need to show that there was a known problem with the prior art system." *Unwired Planet, LLC v. Google Inc.*, 841 F.3d 995, 1002–03 (Fed. Cir. 2016); *see also Sci. Plastic Prods., Inc. v. Biotage AB*, 766 F.3d 1355, 1359–61 (Fed. Cir. 2014); *Hologic, Inc. v. Minerva Surgical, Inc.*, 764 F. App'x 873, 880 (Fed. Cir. 2019). As expressly recognized in *KSR*, any art-recognized need or problem can provide a reason for combining claim elements. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007). Here, Petitioner provides sufficient evidence to demonstrate that saturation was a known problem (*see, e.g.*, Ex. 1003 ¶¶ 104, 109; Ex. 1019, 79;[6] Ex. 1047

[6] It is of no moment that this evidence is not identified as part of the asserted ground. PO Resp. 51. This evidence is cited by Dr. Kenny as support for his testimony, consistent with our rules. 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.").

¶¶ 51–52) and that Schulz provided a readily-applicable technique to solve it (Ex. 1013 ¶ 73). That "easier approaches" may have existed, *see* PO Resp. 48, does not teach away from the approach explicitly taught by Schulz.

We also do not agree with Patent Owner's argument that Schulz and Mendelson-799 are incompatible because they obtain measurements at different locations. Mendelson-799 explains that its sensor type can be used in "multiple convenient locations on the body," and does not exclude use on a patient's ear or elsewhere. Ex. 1012, 2:15–21; *contra* PO Resp. 48– 49; *see also* Ex. 1019, 104 ("The idea of using skin reflectance spectrophotometry marked a significant advancement in the noninvasive monitoring of S_aO_2 from virtually any point on the skin surface."). Moreover, the proposed modification does not seek to bodily incorporate the references, one with the other. Rather, Petitioner clearly proposes modifying Mendelson-799 to include an opaque material with windows, as taught by Schulz, but plainly does not propose incorporating any other aspect of Schulz, such as its measurement location. *See* Pet. 30–34; *see also In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973) ("Combining the teachings of references does not involve an ability to combine their specific structures.").

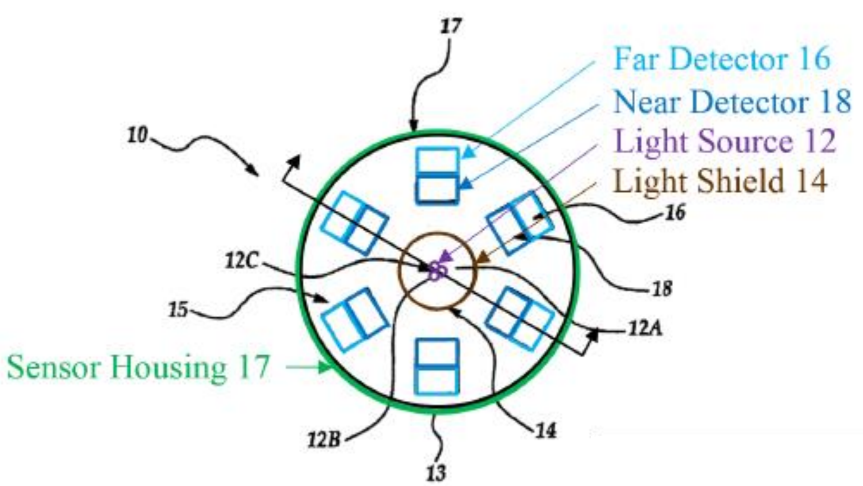
We have considered the remainder of Patent Owner's arguments, but we do not agree with them. For example, it is irrelevant that Schulz teaches only a single window, because Petitioner provides persuasive testimony to show that a skilled artisan would have implemented a window for *each detector* in Mendelson-799's sensor. PO Resp. 49; Ex. 1003 ¶¶ 106–108. It is likewise irrelevant that Schulz discloses an additional "separate cover . . . to block ambient light," because the presence of a separate cover does not

change the fact that Schulz explicitly teaches using its windowed opaque material to avoid detector saturation. *See* Ex. 1013 ¶ 73; *contra* PO Resp. 50; PO Sur-reply 22–23.

For the foregoing reasons, we are persuaded by Petitioner's contentions.

v. "[d] a wall that surrounds at least the at least the four detectors"

The cited evidence supports Petitioner's undisputed contentions regarding this limitation. Pet. 23–24, 47–48. Specifically, Petitioner contends that Mendelson-799 discloses sensor housing 17 that accommodates detectors 16, 18, as shown below in Petitioner's annotated and modified view of Mendelson-799's Figure 7. *Id.* at 23–24; *see, e.g.*, Ex. 1012, 9:22–40 ("All these elements are accommodated in a sensor housing 17."), Fig. 7.

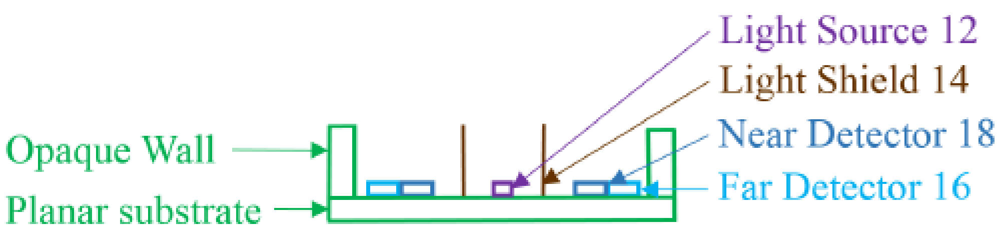


Petitioner's modified figure depicts the sensor of Mendelson-799 with sensor housing 17 identified in green and encircling the detectors. Pet. 24; *see also id.* at 47.

Petitioner acknowledges that Mendelson-799 does not depict a side view of the sensor and thus, to the extent Mendelson-799 does not explicitly

teach that housing 17 includes an opaque wall that surrounds the detectors, a person of ordinary skill in the art would have found it obvious "to connect, to the portion of sensor housing 17, an opaque wall that surrounds the array of discrete detectors . . . both to shield the detectors from ambient light, and protect the detectors from external forces." Pet. 12–13; *see also id.* at 23–24; *see, e.g.*, Ex. 1003 ¶¶ 62–72, 89–117.

Petitioner provides an added sectional view of this proposed modification, shown below.



Petitioner's added figure depicts a side view of the sensor of Mendelson-799 with an opaque wall identified in green and encircling the detectors. Pet. 24; *see also id.* at 47.

Patent Owner does not dispute Petitioner's contentions regarding this limitation. *See generally* PO Resp.; PO Sur-reply.

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny, who testifies that such a wall would "shield the detectors from ambient light, and protect the detectors from external forces." Ex. 1003 ¶ 64; *see also* Ex. 1003 ¶¶ 63–72, 89–91, 132–136.

vi. "[e] cover comprising a protruding convex surface, wherein the protruding convex surface is above all of the at least four detectors, wherein at least a portion of the protruding convex surface is rigid, and wherein the cover operably connects to the wall;"

<u>Petitioner's Undisputed Contentions</u>

Petitioner contends that Mendelson-799 does not disclose a cover above the four detectors, as claimed. Pet. 24–25. Patent Owner does not dispute this contention, and we agree that Mendelson-799 is not shown to include a cover. *See generally* Ex. 1012.

Petitioner relies upon Ohsaki for the recited cover, and contends that:

> Ohsaki discloses a wrist-worn "pulse wave sensor" that includes a light permeable convex cover—"translucent board 8"—that is configured to be located between user tissue and a detector when the sensor is worn, where the cover comprises a protruding convex surface operable to conform [to] tissue of the user, and where a wall operably connects to a substrate and to the cover.

Pet. 25 (citing, e.g., Ex. 1009 ¶¶ 15, 17, 25; Ex. 1003 ¶¶ 73–75, 94). Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki discloses that sensor 1 is "worn on the back side of the user's wrist" and includes translucent board 8, with a convex surface formed on the top of the board, to be placed against a user's tissue. Ex. 1009 ¶¶ 16, 17, Figs. 1–2 (depicting translucent board 8 above detector). As shown in Ohsaki's Figure 2, the board 8 is operably connected to the walls of sensor package 5 that houses the sensor components, including circuit board 9, light emitting element 6 (e.g., LED), and light receiving element 7. *Id.* ¶ 17 ("The translucent board 8 is . . . attached to the opening of the package 5."), Fig. 2.

Petitioner also contends that a person of ordinary skill in the art would have understood the convex surface to be "rigid." Pet. 22, 50–51. Patent

Owner does not dispute this contention, and we agree with Petitioner. As depicted in Ohsaki's Figure 2, the user's tissue 4 is shown to conform to the shape of the protruding convex surface when the sensor is worn by the user. Ex. 1009 ¶ 17 ("The translucent board 8 is a glass board."), Fig. 2; *see, e.g.*, Ex. 1003 ¶¶ 99, 141 (testifying as to the convex surface's rigidity).

<u>Petitioner's Disputed Contentions</u>

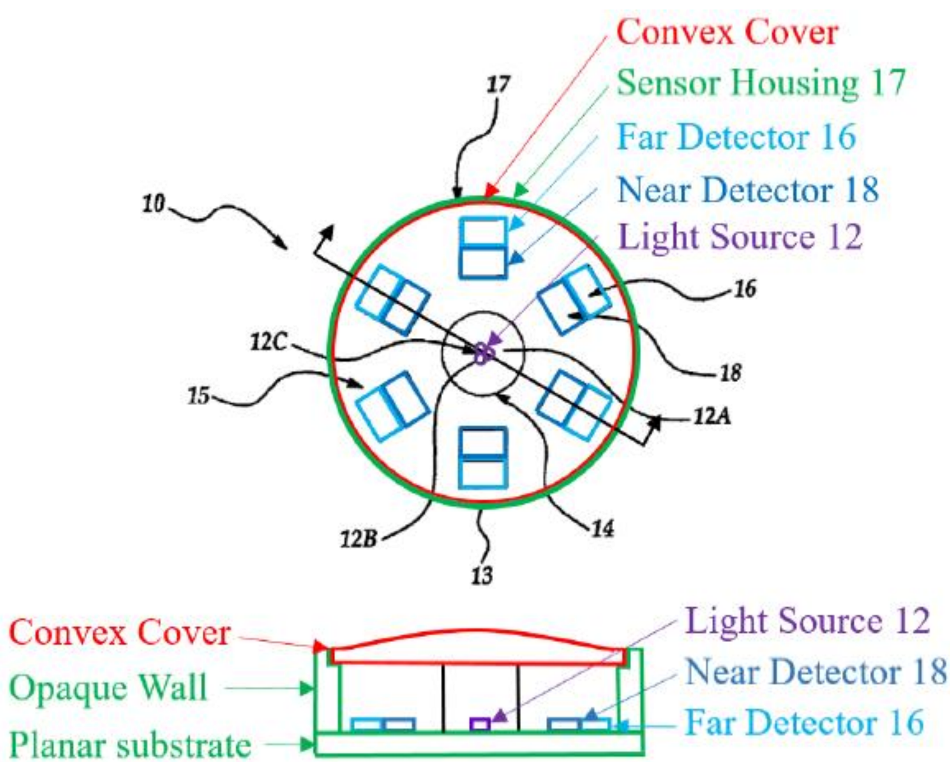
Petitioner further contends that a person of ordinary skill in the art "would have recognized that a light permeable cover with a protruding convex surface," such as that taught by Ohsaki, "would improve adhesion between the sensor and the user's tissue, improve detection efficiency, and protect the elements within sensor housing 17." Pet. 25 (citing, e.g., Ex. 1003 ¶ 92; Ex. 1009 ¶¶ 15, 17, 25), 27–28. Petitioner contends that Ohsaki's convex surface is in intimate contact with the user's tissue, which prevents slippage of the sensor and increases signal strength because "variation of the amount of the reflected light . . . that reaches the light receiving element 7 is suppressed." *Id.* at 25–26 (citing, e.g., Ex. 1003 ¶ 95; quoting Ex. 1009 ¶ 25).

Accordingly, Petitioner contends that, to achieve these identified benefits, a person of ordinary skill in the art would have added a light permeable convex cover to Mendelson-799's sensor, the cover being located "over the array of detectors 16 and 18" when worn. Pet. 27–28 (citing, e.g., Ex. 1003 ¶¶ 98–99; Ex. 1009 ¶¶ 15, 17, 25), 48 (citing, e.g., Ex. 1003 ¶¶ 73–75, 89–100, 137). Petitioner also contends that an ordinarily skilled artisan would have configured the cover to be "rigid to conform tissue of the user to at least a portion of the cover's surface when worn." *Id.* at 28 (citing, e.g., Ex. 1003 ¶ 99), 49–50 (citing, e.g., Ex. 1003 ¶¶ 73–75, 89–100, 140–141).

Additionally, Petitioner contends the skilled artisan would have "configured a circumscribing wall in Mendelson-799's sensor to operably connect" to the sensor's planar substrate and to the convex cover. Pet. 28 (citing, e.g., Ex. 1003 ¶ 99), 49–50 (citing, e.g., Ex. 1003 ¶¶ 73–75, 89–100, 140–141).

Petitioner contends these modifications would have been "nothing more than the use of a known technique to improve similar devices in the same way, and combining prior art elements according to known methods to yield predictable results—improved adhesion of the sensor to the user's skin, and improved signal strength." *Id.* at 29 (citing, e.g., Ex. 1003 ¶¶ 62–75, 100).

To illustrate its proposed modification, Petitioner includes an annotated and modified view of Mendelson-799's Figure 7, as well as an added sectional view, both of which are reproduced below. Pet. 29 (citing Ex. 1003 ¶¶ 99–100), 49 (citing Ex. 1003 ¶¶ 73–75, 89–100, 137–138).



Petitioner's modified and added figures depict the sensor of Mendelson-799 with an added convex cover (illustrated in red) connected to the wall of Mendelson-799's sensor (illustrated in green, *see supra* § II.D.5.v). Pet. 29.

Patent Owner's Arguments

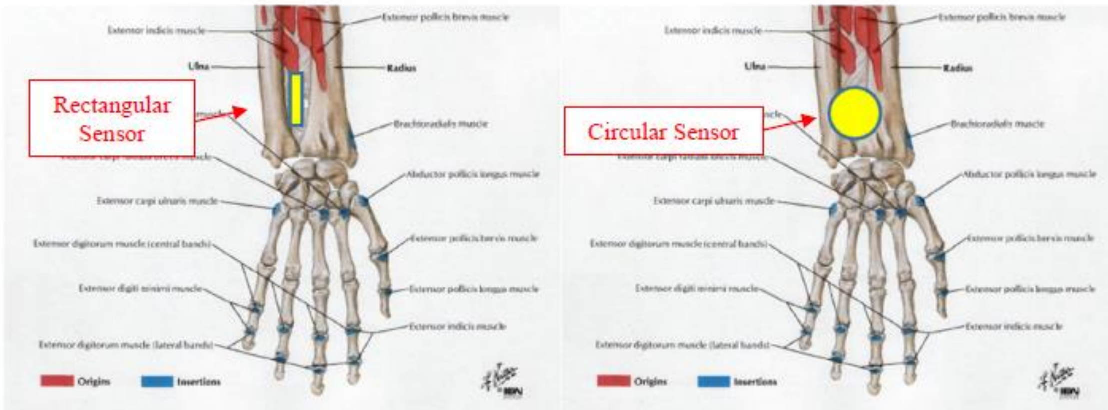
Patent Owner argues that a person of ordinary skill in the art would not have been motivated to modify Mendelson-799's sensor to include Ohsaki's convex cover. PO Resp. 22–47; PO Sur-Reply 2–21.

First, Patent Owner argues that the proposed modification "changes Ohsaki's structure and eliminates the longitudinal shape that gives Ohsaki's translucent board the ability to fit within the user's anatomy and prevent slipping." PO Resp. 23. This argument is premised on Patent Owner's contention that Ohsaki's convex cover must be rectangular, with the cover's long direction aligned with the length of the user's forearm, to avoid interacting with bones in the wrist and forearm. *Id.* at 24–25 (citing, e.g., Ex. 2004 ¶¶ 51–54; Ex. 1009 ¶¶ 6, 19, 23, 24); PO Sur-reply 2–10. According to Patent Owner, Ohsaki teaches that "aligning the sensor's longitudinal direction with the ***circumferential*** direction of the user's arm undesirably results in 'a tendency [for Ohsaki's sensor] to slip off.'" PO Resp. 25–26 (citing Ex. 1009 ¶ 19), 27–28.

Thus, Patent Owner contends that Petitioner's proposed modification would "chang[e] Ohsaki's rectangular board into a ***circular*** shape," which "would eliminate the advantages discussed above" because it "cannot be placed in ***any longitudinal*** direction and thus cannot coincide with the longitudinal direction of the user's wrist." *Id.* at 26 (citing Ex. 2004 ¶¶ 55–56). Patent Owner presents annotated Figures depicting what it contends is

Ohsaki's disclosed sensor placement as compared to that of the proposed modification, reproduced below.

Ohsaki's Longitudinal Teachings Petitioner's Proposed Combination



Patent Owner's annotated Figure on the left depicts a rectangular sensor placed between a user's radius and ulna, while Patent Owner's annotated Figure on the right depicts a circular sensor placed across a user's radius and ulna. PO Resp. 27. Based on these annotations, Patent Owner argues that the proposed "circular shape would press on the user's arm in all directions and thus cannot avoid the undesirable interaction with the user's bone structure," such that a skilled artisan "would have understood such a change would eliminate Ohsaki's benefit of preventing slipping." *Id.* at 27–28 (citing, e.g., Ex. 2004 ¶¶ 55–58).

Second, Patent Owner argues that Ohsaki requires its sensor be placed on the back of the user's wrist to achieve any benefits, but that such a location would have been unsuitable for Mendelson-799's sensor, and would result in weak sensor signals. PO Resp. 32. Relying on other publications by the named inventor on Mendelson-799, Patent Owner alleges that sensor signals were difficult or impossible to discern from the wrist, even with considerable pressure. *Id.* at 32 (citing Ex. 2003, 3–4), 33–34 (citing

Ex. 2015, 3, 4; Ex. 2014, 1, 99). Patent Owner contends that Dr. Kenny admitted that signals from the wrist are weaker and noisier than from other locations. *Id.* at 33 (citing Ex. 2008, 249:10–16, 255:12–21), 34–37 (citing Ex. 2017, 2; Ex. 2018, 4; Ex. 2010, 44, 71; Ex. 2016, 2, 3).

Third, Patent Owner argues that a person of ordinary skill in the art would not have placed Ohsaki's convex cover over Mendelson-799's peripheral detectors because the convex cover would condense light toward the center and away from the detectors, which would decrease signal strength. PO Resp. 38–43 (citing, e.g., Ex. 2004 ¶¶ 71–76). Patent Owner also contends that Petitioner and Dr. Kenny admit as much, fail to account for the impact of the proposed modification on light collection, and fail to propose a specific three-dimensional structure to embody the proposed modification. *Id.* (citing, e.g., Ex. 2020, 69–70; Ex. 2006, 204:14–20; Ex. 2008, 36:19–37:1, 57:19–58:16, 63:5–64:8, 170:12–171:1, 173:8–15). Patent Owner relies on Figure 14B of the '765 patent, which Patent Owner contends supports its position. *Id.* at 39–40 (citing Ex. 1001, 36:3–6, 36:13–15).

Fourth, Patent Owner argues that Ohsaki's rectangular cover creates air gaps at its peripheral edges, as shown in Ohsaki's Figure 1, which Mendelson-799 cautions against as potentially causing "specular reflection." PO Resp. 43–44 (citing, e.g., Ex. 1012, 2:58–64). Accordingly, Patent Owner argues that a person of ordinary skill in the art "would not have modified Mendelson[-]799's structure to add Ohsaki's air gaps." *Id.* at 44–45 (citing Ex. 2004 ¶¶ 77–80).

Fifth, Patent Owner argues that "a convex cover is just one of many different alternatives for protecting the components of a sensor" including,

e.g., resin or encapsulation. PO Resp. 45–46. Concerning possible alternatives, Patent Owner contends that a person of ordinary skill in the art "would have understood that a flat cover would provide ***better protection*** than a convex surface because—as Petitioner's cited art teaches—a flat cover would be less prone to scratches." *Id.* at 46–47 (citing Ex. 1008 ¶ 106; Ex. 2004 ¶¶ 81–82).

<u>Petitioner's Reply</u>

Concerning Patent Owner's first and second arguments, Petitioner responds that Ohsaki does not disclose the shape of its protrusion, other than its convexity as shown in Figures 1 and 2, nor does Ohsaki require a rectangular shape or placement on the back of the wrist in order to achieve the disclosed benefits. Pet. Reply 7–14 (citing, e.g., Ex. 1047 ¶¶ 17–28). Moreover, Petitioner asserts that "even if Ohsaki's translucent board 8 were somehow understood to be rectangular, obviousness does not require 'bodily incorporation' of features from one reference into another"; rather, a person of ordinary skill in the art "would have been fully capable of attaching a light permeable protruding convex cover to Me[nd]elson-799's housing to obtain the benefits attributed to such a cover by Ohsaki." *Id.* at 10–11 (citing, e.g., Ex. 1047 ¶ 23). Similarly, regarding the location of the sensor, Petitioner asserts,

> [E]ven if a [person of ordinary skill in the art] would have somehow misunderstood Ohsaki's sensor as limited to placement on the backside of the wrist, and even if the difficulty that [Patent Owner] alleges with respect to obtaining pulse oximetry measurements from that location were true, that ***would have further motivated*** the [person of ordinary skill in the art] to implement a light permeable convex cover in Mendelson-799's sensor, to improve detection efficiency.

Id. at 12 (citing, e.g., Ex. 1047 ¶ 26).

Concerning Patent Owner's third argument, Petitioner responds that adding a convex cover to Mendelson-799's sensor would not decrease signal strength but, instead, "would improve Mendelson-799's signal-to-noise ratio by causing more light backscattered from tissue to strike Mendelson-799's detectors than would have absent the cover" because such a cover improves light concentration across the entire lens and does not direct it only towards the center. *Id.* at 14–18 (citing, e.g., Ex. 1047 ¶¶ 29–44).

Petitioner dismisses Patent Owner's reliance on Figure 14B of the '765 patent because it "is not an accurate representation of light that has been reflected from a tissue measurement site. The light rays (1420) shown in FIG. 14B are collimated (i.e., travelling paths parallel to one another), and each light ray's path is perpendicular to the detecting surface." Pet. Reply 16 (citing, e.g., Ex. 1047 ¶¶ 30–35). Moreover, Petitioner argues that, "Dr. Madisetti's overly-simplistic statements only apply to a special narrow case of collimated light incident on a convex lens along the axis of symmetry." *Id.* at 16 (citing, e.g., Ex. 1047 ¶ 36).

According to Petitioner, Patent Owner's and Dr. Madisetti's argument regarding convergence toward the center does not apply to diffuse light, which reaches the detectors from various random angles and directions after having been reflected by tissue. *Id.* at 16–17 (citing, e.g., Ex. 1047 ¶¶ 37–38). As a result, Petitioner contends Ohsaki's cover would have provided a refracting effect such that light rays that would have missed the detectors absent a cover are instead directed to that area as they pass through the cover. *Id.* at 17 (citing Ex. 1047 ¶¶ 38–39). Petitioner thus contends that "overall, more of the partially reflected, transmitted, absorbed, and

ultimately back scattered light strikes the detectors than otherwise would have absent the cover." *Id.* at 17–18 (citing Ex. 1047 ¶¶ 40).

Concerning Patent Owner's fourth argument, Petitioner responds that a skilled artisan would have known to avoid air gaps in the proposed combination. *Id.* at 19–20 (citing, e.g., Ex. 1047 ¶¶ 45–48).

Concerning Patent Owner's fifth argument, Petitioner responds that even if a flat surface might be less prone to scratching, that possible disadvantage would have been weighed against the "***multiple*** advantages of a convex cover," and would not negate a motivation to combine. *Id.* at 20 (citing, e.g., Ex. 1047 ¶ 49).

<u>Patent Owner's Sur-reply</u>

Concerning Patent Owner's first and second arguments, Patent Owner reiterates its position that Ohsaki's purported benefits attach only to a sensor with a rectangular convex surface that is located on the back of the wrist, and that "even small changes in its sensor orientation or body location result in 'a tendency to slip.'" PO Sur-reply 2–15, 6.

Concerning Patent Owner's third argument, Patent Owner argues that Dr. Kenny and Petitioner have not overcome their admissions that a convex lens directs light toward the center. *Id.* at 15–16 (citing, e.g., Ex. 2004 ¶¶ 72–76).

Patent Owner also asserts that Petitioner mischaracterizes Patent Owner's position, which is not that a convex cover focuses "all light" to a single point at the center of the sensor. *Id.* at 17. Patent Owner instead states that, "a convex surface would direct relatively more light towards the center and away from Mendelson '799's peripheral detectors" and that "any signal strength from light redirected from the edge would be weak and fail to

compensate for the much stronger lost signal strength from light directed towards the center." *Id.* at 17, 18.

Finally, Patent Owner argues that Petitioner's Reply arguments are overly complex and instead a person of ordinary skill in the art "would have understood and applied the straightforward understanding that a convex surface condenses light toward the center." *Id.* at 19.

Concerning Patent Owner's fourth argument, Patent Owner argues that "Petitioner does not dispute [that] air gaps would dissuade a [person of ordinary skill in the art] from modifying Mendelson[-]799." *Id.* at 19–21.

Concerning Patent Owner's fifth argument, Patent Owner argues that Petitioner does not dispute Patent Owner's position that a flat cover would be less prone to scratches and offers "***no*** plausible advantages for its asserted combination." *Id.* at 21. Moreover, Patent Owner argues that "the risk of scratches directly undermines Petitioner's argument that a [person of ordinary skill in the art] would have included a convex cover instead of a flat surface to provide 'additional protection.'" *Id.*

<u>Analysis</u>

As noted above, Petitioner provides three rationales to support its contention that a person of ordinary skill in the art would have provided "a light permeable cover with a protruding convex surface," such as that taught by Ohsaki, to Mendelson-799's sensor: (1) to "improve adhesion between the sensor and the user's tissue," (2) to "improve detection efficiency," and (3) to "protect the elements within sensor housing 17." Pet. 25 (citing, e.g., Ex. 1003 ¶ 92; Ex. 1009 ¶¶ 15, 17, 25), 27–28. We conclude all three rationales are supported by the evidence, as follows.

Rationales 1 and 2

The evidence of record persuades us that a person of ordinary skill in the art would have been motivated to add a convex cover, such as that taught by Ohsaki, to improve adhesion between the sensor and the user's skin, which would have increased the signal strength of the sensor. Ohsaki teaches as much:

> [T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby *it is prevented that the detecting element 2 slips off* the detecting position of the user's wrist 4. If the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4 as shown in Fig. 4B. However, in the case that the translucent board 8 has a convex surface like the present embodiment, the *variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8*. Therefore, the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25 (emphases added); *see also id.* ¶ 27 ("stably fixed").

We credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated by such teachings to apply a cover with a convex surface to Mendelson-799 to improve that similar device in the same way and to yield predictable results, i.e., to resist movement of the sensor on the user's wrist. *See, e.g.*, Ex. 1003 ¶ 95 ("[T]his contact [between the convex surface and the user's skin] prevents slippage, which increases the strength of the signals obtainable by Ohsaki's sensor."). We also credit Dr. Kenny's testimony that, in light of these teachings, a person of ordinary skill in the art would have made such a modification to improve the pulse

sensor's ability to emit light into, and detect light reflected from, the user's wrist, to generate an improved pulse signal. Ex. 1003 ¶¶ 95–98; Ex. 1047 ¶¶ 10, 12.

Indeed, Ohsaki expressly compares the performance of a wrist-worn pulse wave sensor depending on whether translucent board 8 is convex or flat, and concludes the convex surface results in improved performance over the flat surface, especially when the user is moving. Ex. 1009, Figs. 4A–4B, ¶¶ 15, 25 (stating that with "a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4," and with "a convex surface like the present embodiment, the variation of the amount of the reflected light" collected by the sensor "is suppressed"). Ohsaki also states that, with a convex surface, "[i]t is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8." *Id.* ¶ 25.

We also credit Dr. Kenny's testimony that the proposed modification would have been within the level of ordinary skill in the art. For example, Dr. Kenny testifies:

> The above-described modification would require only routine knowledge of sensor design and assembly, which were well within the skill of one of ordinary skill prior to the Critical Date. Indeed, the modification would have amounted to nothing more than the use of a known technique to improve similar devices in the same way, and combining prior art elements according to known methods to yield predictable results—improved adhesion of the sensor to the user's skin, and improved signal strength. Furthermore, the elements of the resulting sensor would each perform functions they had been known to perform prior to the combination—a cover would simply be placed over the components (e.g., detectors) accommodated within

> Mendelson-799's sensor housing 17, and would perform the same function as taught by Ohsaki.

Ex. 1003 ¶ 100. In light of Ohsaki's express disclosure of the benefits of a convex cover, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to modify Mendelson-799 as proposed, and would have had a reasonable expectation of success in doing so.

We next address Patent Owner's first through fourth arguments, each of which implicates Petitioner's first and second asserted rationales of improved adhesion and detection efficiency.

Patent Owner's first argument is premised on the notion that Ohsaki's benefits only can be realized with a rectangular convex surface, because such a shape is required to avoid interacting with bones on the back of the user's forearm. PO Resp. 23–31. We disagree. Ohsaki does not disclose the shape of its convex cover, much less require it be rectangular. In fact, Ohsaki is silent as to the shape of the convex surface. Ohsaki discloses that sensor 1 includes detecting element 2, which includes package 5 within which the sensor components are located. Ex. 1009 ¶ 17. Ohsaki's convex surface is located on board 8, which is "attached to the opening of the package 5." *Id.* Ohsaki provides no further discussion regarding the shape of board 8 or its convex surface.

We disagree with Patent Owner's suggestion that the shape of the convex surface can be inferred to be rectangular from Ohsaki's Figures 1 and 2. PO Resp. 13, 17–18. Ohsaki does not indicate that these figures are drawn to scale, or reflect precise dimensions or shapes of the convex surface. *See, e.g.*, Ex. 1009 ¶ 13 ("schematic diagram"); Pet. Reply 9–10;

Hockerson-Halberstadt, Inc. v. Avia Group Int'l, 222 F.3d 951, 956 (Fed. Cir. 2000) ("[I]t is well established that patent drawings do not define the precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue.").

To be clear, Ohsaki describes the shape of *detecting element 2* as rectangular: "[T]he length of the detecting element from the right side to the left side in FIG. 2 is longer than the length from the upper side to the lower side." Ex. 1009 ¶ 19. Ohsaki also describes that detecting element 2 is aligned longitudinally with the user's forearm: "[I]t is desirable that the detecting element 2 is arranged so that its longitudinal direction agrees with the longitudinal direction of the user's arm," to avoid slipping off. *Id.*; *see also id.* ¶ 9 ("The light emitting element and the light receiving element are arranged in the longitudinal direction of the user's arm.").

In light of this disclosed rectangular shape of detecting element 2, it is certainly possible that Ohsaki's convex surface may be similarly shaped. But, it may not be. Contrary to Patent Owner's argument, Ohsaki neither describes nor requires detecting element 2 to have the same shape as the convex surface of board 8. *Accord* Pet. Reply. 7–8 (noting also that Ohsaki's board 8 "is not coextensive with the entire tissue-facing side of detecting element 2"). We have considered the cited testimony of both Dr. Kenny and Dr. Madisetti on this point. Ex. 1047 ¶¶ 10–12, 12 n.2, 17–23; Ex. 2004 ¶¶ 37–41 (relying on Ohsaki's Figures 1–2 to support his opinion that the convex surface is rectangular). Dr. Madisetti's reliance on the dimensions of Ohsaki's figures is unpersuasive. *Hockerson-Halberstadt*, 222 F.3d at 956. We credit Dr. Kenny's testimony that Ohsaki does not

describe its convex surface as rectangular, because this testimony is most consistent with Ohsaki's disclosure.

Further, Patent Owner suggests that the convex surface *must be* rectangular, in order to avoid interacting with bones in the user's forearm. PO Resp. 27–28; PO Sur-Reply 10 ("[A] POSITA would have understood Ohsaki's convex board must also have a longitudinal shape oriented up-and-down the watch-side of the user's wrist/forearm."). Although Ohsaki recognizes that interaction with these bones can cause slippage problems, *see* Ex. 1009 ¶¶ 6, 19, we do not agree that the *only way* to avoid these bones is by aligning a rectangular cover with the longitudinal direction of the user's forearm. For example, in the annotated Figures provided by Patent Owner, *see* PO Resp. 27, we discern that the circular sensor that purports to depict the proposed modification would *also* avoid the bones in the forearm if it were slightly smaller. Patent Owner provides no persuasive explanation to justify the dimensions it provides in this annotated figure, or to demonstrate that such a large sensor would have been required. Indeed, we discern that it would have been within the level of skill of an ordinary artisan to appropriately size a modified sensor to avoid these well-known anatomical obstacles. "A person of ordinary skill is also a person of ordinary creativity, not an automaton." *KSR*, 550 U.S. at 421. After all, an artisan must be presumed to know something about the art apart from what the references disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962).

Finally, we do not agree with Patent Owner's position that Ohsaki's advantages apply only to rectangular convex surfaces. As discussed, Patent Owner has not shown that Ohsaki's convex surface is rectangular at all. Moreover, even if Ohsaki's convex surface is rectangular, when discussing

the benefits associated with a convex cover, Ohsaki does not limit those benefits to a cover of any particular shape. Instead, Ohsaki explains that "detecting element 2 is arranged on the user's wrist 4 so that the convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby it is prevented that the detecting element 2 slips off the detecting position of the user's wrist 4." Ex. 1009 ¶ 25; Ex. 1047 ¶ 10. Thus, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Mendelson-799's circular-shaped sensor, to improve adhesion as taught by Ohsaki. *See, e.g.*, Pet. 24–25, 27–28. Nothing in Ohsaki's disclosure limits such a benefit to a specific shape of the convex surface. Ex. 1047 ¶¶ 11–12.

Moreover, Ohsaki contrasts its convex surface with a flat surface and notes that,

> in the case that the translucent board 8 has a convex surface . . . the variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8. Therefore, the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25; Ex. 1047 ¶ 11. Thus, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Mendelson-799's sensor, to improve signal strength, as taught by Ohsaki. *See, e.g.*, Pet. 24–25, 27–28. Again, nothing in Ohsaki's disclosure limits such a benefit to the shape of the convex surface. Ex. 1047 ¶¶ 11–12.

Accordingly, we do not agree that Ohsaki's disclosed advantages attach only to a rectangular convex surface, or would have been inapplicable to the proposed combination of Mendelson-799 and Ohsaki.[7]

We have considered Patent Owner's second argument, that Ohsaki's benefits are realized only when the sensor and convex surface are placed on the back of the user's wrist, which is an unsuitable location for Mendelson-799's sensor. PO Resp. 32–38. We do not agree. As an initial matter, Petitioner does not propose bodily incorporating the references; Petitioner simply proposes adding a convex cover to Mendelson-799's sensor, without discussing where Mendelson-799's sensor is used. *See, e.g.*, Pet. 27–28. In other words, Petitioner's proposed modification does not dictate any particular placement. Moreover, Mendelson-799 states that its sensor "allows for measuring SaO_2 from multiple convenient locations on the body (e.g. the head, torso, or upper limbs)." Ex. 1012, 2:17–19; *see also* Ex. 1019, 104 ("The idea of using skin reflectance spectrophotometry marked a significant advancement in the noninvasive monitoring of S_aO_2 from virtually any point on the skin surface."). Thus, we do not agree that Mendelson-799 discourages or disparages use on the back of the wrist.

Notwithstanding the foregoing, and assuming for sake of argument that Patent Owner is correct that a person of ordinary skill in the art would have expected a weaker signal from Mendelson-799's sensor if placed on the wrist, *see* PO Resp. 32, that alone does not nullify the proposed

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[7] Patent Owner also argues that it would not have been obvious to place a rectangular cover on top of Mendelson-799's sensor. PO Resp. 29–31. We do not understand Petitioner to have made any such contention and, accordingly, do not address this argument. *See, e.g.*, Pet. 29, 49 (depicting circular convex surface over circular sensor).

combination. "[A] given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine." *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) (citation omitted). Indeed, we discern that, if Mendelson-799's sensor was placed at a location that results in decreased signal quality, a person of ordinary skill in the art would have been further motivated to act to improve signal quality, e.g., by employing Ohsaki's convex surface. *See, e.g.*, Ex. 1047 ¶¶ 26–28; Ex. 1009 ("[I]n the case that the translucent board 8 has a convex surface like the present embodiment, the variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8.").

We have considered Patent Owner's third argument that a convex cover would condense light away from Mendelson-799's peripheral detectors, which Patent Owner alleges would decrease signal strength. PO Resp. 38–43. We disagree. There appears to be no dispute that when emitted light passes through user tissue, the light is diffused and scattered as it travels. *See, e.g.*, Pet. Reply 16–17; Tr. 33:13–34:7 (Patent Owner's counsel agreeing that "when [light] goes into the tissue you get the diffusion and that is random scattering"); Ex. 1052, 35:19–37:18 (Patent Owner's declarant describing light scattering as it travels through tissue, e.g., reflecting off blood, tissue, or other material); Ex. 1054, 28:2–10 (Patent Owner's declarant agreeing that reflected light can be a signal to a sensor), 61:20–62:4 (explaining that "a light in this context, light emitted from the LEDs is diffused through the skin in that particular context, whatever that

is.”). The light thus travels at random angles and directions, and no longer travels in a collimated and perpendicular manner.

Dr. Kenny testifies that Mendelson-799 and Ohsaki “detect light that has been ‘partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector.” Ex. 1047 ¶ 37. Dr. Kenny further opines that, “the POSITA would have understood that Mendelson-799’s sensor, which includes multiple photodiodes placed symmetrically with respect to a central light source, offers the advantage of *enabling a large fraction of light randomly backscattered from tissue to be detected within the circular active detection area surrounding that source*,” thus increasing the light-gathering ability of Mendelson-799’s sensor. *Id.* ¶ 38 (emphasis added); *see also id.* ¶ 39 (“Ohsaki’s cover provides a slight refracting effect, such that light rays that otherwise would have missed the detection area are instead directed toward that area as they pass through the interface provided by the cover.”).

By contrast Dr. Madisetti testifies that “a convex surface condenses light away from the periphery and towards the sensor’s center.” Ex. 2004 ¶ 74. We have considered this testimony; however, Dr. Madisetti’s opinions largely are premised upon the behavior of collimated and perpendicular light as depicted in Figure 14B of the challenged patent. *See id.* Dr. Madisetti does not explain how light would behave when approaching the sensor from various angles, as it would after being reflected by tissue. *Id.* ¶¶ 72–76. In other words, even if Patent Owner is correct that the ’765 patent’s Figure 14B depicts light condensing toward the center, this is not dispositive to the proposed modification, because light passing through a user’s tissue is

scattered and random, and is not collimated and perpendicular as shown in Figure 14B. Ex. 1001, Fig. 14B.

Patent Owner and Dr. Madisetti argue that "Petitioner and Dr. Kenny both previously admitted that a convex cover condenses light towards the center of the sensor and away from the periphery in a different petition filed against a related patent," i.e., in IPR2020-01520. PO Resp. 38–39; Ex. 2004 ¶¶ 72–73 (citing Ex. 2019, 45; Ex. 2020 ¶¶ 118–120). The cited portions of the Petition and Dr. Kenny's declaration from IPR2020-01520 discuss a decrease in the "mean path length" of a ray of light when it travels through a convex lens rather than through a flat surface. *See, e.g.*, Ex. 2020 ¶¶ 118–120. We do not agree that this discussion is inconsistent with Dr. Kenny's testimony here that, where light is reflected to the detectors at various random angles and directions, more light will reach Mendelson-799's symmetrically disposed detectors when travelling through the convex surface than would be reached without such a surface, because light that might have otherwise missed the detectors now will be captured. Ex. 1047 ¶¶ 37–40. We do not discern that the convergence of a single ray of light toward the center, as discussed in IPR2020-01520, speaks to the aggregate effect on *all* light that travels through the convex surface. Patent Owner suggests that this prior discussion means that all light is always directed toward the center regardless of where or how the light approaches the convex surface, however, we do not understand Dr. Kenny's testimony to support such a position. PO Resp. 38–39.

In its Sur-reply, Patent Owner argues that it "never argued all incoming light condenses to a ***single point***." PO Sur-reply 17. Be that as it may, neither Patent Owner nor Dr. Madisetti sufficiently address the diffuse

nature of the light at issue here, which reflects from user tissue and scatters. Ex. 2004 ¶¶ 71–75. Accordingly, considering all evidence of record, we credit the testimony of Dr. Kenny.[8]

With respect to Patent Owner's fourth argument, we do not agree that a person of ordinary skill in the art would have been discouraged from modifying Mendelson-799 as proposed, due to the potential for air gaps to form at the peripheral edges of the convex surface. PO Resp. 43–45. Patent Owner misstates the proposed modification. Petitioner does not propose "modif[ying] Mendelson[-]799's structure to add Ohsaki's air gaps." *Contra* PO Resp. 44. Petitioner proposes modifying Mendelson-799 only to include a cover with a convex surface; Petitioner does not propose including any air gaps that may be present in Ohsaki. *See, e.g.*, Pet. 48. Moreover, even if Ohsaki's Figure 1 depicts small air gaps adjacent the convex surface, Ohsaki nonetheless discloses that the convex surface is in "intimate contact" with the user's skin. Ex. 1009 ¶ 25; *Hockerson-Halberstadt*, 222 F.3d at 956. In view of such a teaching, we agree with Petitioner that it would have been within the skill of a person of ordinary skill in the art, who "is also a person of ordinary creativity, not an automaton," to minimize any such air gap that may be present when including a cover with a convex surface in Mendelson-799's sensor. *KSR*, 550 U.S. at 421. Indeed, a purpose of Petitioner's proposed modification is to increase signal strength. *See, e.g.*,

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[8] Moreover, we disagree with Patent Owner's argument that Petitioner's Reply arguments are overly complex and instead a person of ordinary skill in the art "would have understood and applied the straightforward understanding that a convex surface condenses light toward the center." PO Sur-reply 19. As noted above, Patent Owner's "straightforward understanding" lacks sufficient support, in the context of diffuse light.

Pet. 26. We discern that it would have been within the capability of an ordinarily skilled artisan to eliminate any air gap that would have decreased signal strength or quality. Ex. 1047 ¶ 47.

Rationale 3

Petitioner further contends that a person of ordinary skill in the art "would have recognized that a light permeable cover with a protruding convex surface," such as that taught by Ohsaki, would "protect the elements within sensor housing 17" of Mendelson-799. Pet. 25. We are persuaded that adding a convex cover, such as that taught by Ohsaki, would protect the sensor's internal components. Mendelson-799 is not shown to include a cover over its emitters 12a–c or detectors 16, 18. *See, e.g.*, Ex. 1012, Fig. 7. By contrast, Ohsaki discloses that translucent board 8 with its convex surface covers its emitter and detector. As such, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to add a transparent convex cover to Mendelson-799 to "provide additional protection to the elements accommodated within sensor housing 17." Ex. 1003 ¶ 98; *see also* Ex. 1008 ¶ 15 (noting that a cover "protect[s] the LED or PD").

We disagree with Patent Owner's fifth argument that a person of ordinary skill in the art would not have modified Mendelson-799 as proposed because a convex cover would be prone to scratches and because other alternatives existed. PO Resp. 45–47. Indeed, we discern that a convex cover would indeed serve to protect internal sensor components better than Mendelson-799, which lacks a cover entirely. That a convex cover may be more prone to scratches than a flat cover is one of numerous tradeoffs that a person of ordinary skill in the art would consider, in

determining whether the benefits of increased adhesion, signal strength, and protection outweigh the potential for a scratched cover. *Medichem*, 437 F.3d at 1165. The record does not support the premise that the possibility of scratches alone would have dissuaded a person of ordinary skill in the art from the proposed modification, to achieve the benefits identified by Petitioner.

For the foregoing reasons, we are persuaded by Petitioner's contentions.

vii. "[f] a handheld computing device in wireless communication with the physiological sensor device, wherein the handheld computing device comprises"

<u>Petitioner's Undisputed Contentions</u>

Petitioner relies upon the teachings of Mendelson-799, Ohsaki, and Schulz, as discussed above, in further combination with Mendelson-2006 for the remainder of the claim limitations [f–k]. Specifically, Petitioner contends that although Mendelson-799 does not explicitly disclose wireless communication from its sensor to a handheld computing device, its sensor is "for use in an optical measurement device" as part of "a method for non-invasive measurement of a blood parameter." Pet. 35–36. Patent Owner does not dispute this contention and we agree with Petitioner. *See*, *e.g.*, Ex. 1012, code (57) ("A sensor for use in an optical measurement device and a method for non-invasive measurement of a blood parameter.").

Petitioner also contends that Mendelson-2006 discloses a body-worn pulse oximetry system including a sensor module, a receiver module, and a PDA. Pet. 37. Petitioner contends that data processed by the receiver module is transmitted to the PDA and identifies several advantages of

wireless communication noted in Mendelson-2006, including more effective medical care. *Id.* at 37–40. Patent Owner does not dispute this contention and we agree with Petitioner. *See*, *e.g.* Ex. 1010, 1–2 (describing system), 3 ("The stream of data received from the wearable unit is distributed to various locations on the PDA's graphical display."), 4 (explaining that wireless communication results in "more effective medical care"); Fig. 1 (sensor attached to skin), Fig. 3 (PDA).

<u>Petitioner's Disputed Contentions</u>

Petitioner further contends a person of ordinary skill in the art would have found it obvious to enable the sensor of the combination of Mendelson-799, Ohsaki, and Schulz to communicate wirelessly with a handheld computing device such as the PDA of Mendelson-2006, to transfer sensor data and provide more effective care. Pet. 36, 51, 55; *see*, *e.g.*, Ex. 1003 ¶¶ 110–117, 145–151.

<u>Patent Owner's Arguments</u>

Patent Owner presents several arguments directed to Mendelson-2006, including that Mendelson-2006 discloses a single detector (PO Resp. 52), and that Mendelson-2006's sensor is used on the forehead (*id.* at 53). Patent Owner argues that Mendelson-2006 thus confirms that a person of ordinary skill in the art would not have combined Mendelson-799 with Ohsaki or Schulz due to signal strength issues raised by various locations where a sensor might be attached to the user's body. *Id.* at 53–55.

<u>Analysis</u>

We are persuaded that Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the testimony of

Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 110–117, 145–151. For example, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to implement Mendelson-799 as part of a physiological measurement system including a handheld communication device in wireless communication, in order to enable transfer of information and improve medical care. *Id.* ¶¶ 116–117.

Moreover, we disagree with Patent Owner's arguments. First, we are persuaded by Petitioner's contentions regarding Mendelson-799, Ohsaki, and Schulz, for the reasons discussed above, and we do not discern that the teachings of Mendelson-2006 undercut those contentions in any manner. Second, Petitioner relies on Mendelson-2006 for teachings regarding wireless communications with a handheld device. Pet. 51–55. Patent Owner's arguments do not pertain to the modification actually proposed, i.e., to enable wireless communication and, as such, are misplaced.
Dr. Madisetti's testimony likewise fails to address substantively the modification actually proposed, i.e., wireless communications to a handheld computing device. Ex. 2004 ¶¶ 93–96.

viii. "[g] one or more processors configured to wirelessly receive one or more signals from the physiological sensor device, the one or more signals responsive to at least a physiological parameter of the user"

The cited evidence supports Petitioner's contention that Mendelson-2006 describes wirelessly transmitting vital physiological information acquired from the sensor to the PDA, which receives it. Pet. 56–57; *see, e.g.*, Ex. 1010, 1, 2 ("The information acquired by the Sensor Module is transmitted wirelessly via an RF link over a short range to a body-worn Receiver Module. The data processed by the Receiver Module can be

transmitted wirelessly to a PDA.”), 3 (explaining that the PDA “has sufficient computational resources for the intended application” and “can also serve to temporarily store vital medical information received from the wearable unit”), Fig. 3 (displaying SpO_2 and HR data); Ex. 1003 ¶¶ 110–117, 152.

Petitioner further contends that, in light of these teachings, a person of ordinary skill in the art “would have found configured a processor of the PDA to receive signals wirelessly from the physiological sensor device, the signals being responsive to physiological parameters of the user.” Pet. 56; *see, e.g.*, Ex. 1003 ¶ 153.

Petitioner’s stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny. Ex. 1003 ¶¶ 152–156. Patent Owner does not present any argument against this limitation, apart from the arguments already addressed in Section II.D.5.vii.

ix. “[h]–[j] a touch-screen display configured to provide a user interface, wherein: the user interface is configured to display indicia responsive to measurements of the physiological parameter, and an orientation of the user interface is configurable responsive to a user input”

The cited evidence supports Petitioner’s contention that Mendelson-2006 describes a PDA with a touchscreen display configured to display indicia responsive to measurements of, e.g., SpO_2 and HR. Pet. 57–60; *see, e.g.*, Ex. 1010, 3 (“The use of a PDA . . . also provides a low-cost touch screen interface.”).

Petitioner acknowledges that “Mendelson-2006 does not explicitly state that an orientation of the GUI provided by the PDA is configurable

responsive to a user input." Pet. 59. However, Petitioner contends that a person of ordinary skill in the art would have understood that "the LabVIEW software that was used 'to control all interactions between the PDA and the wearable unit via [t]he graphical user interface' included the option to configure an orientation of a user interface," e.g. by setting the report orientation to portrait or landscape view. *Id.* at 59–60 (alteration in original); *see, e.g.*, Ex. 1003 ¶¶ 161–162; Ex. 1027, 186 ("Set the report orientation—portrait or landscape.").

Petitioner further contends that, in light of these teachings, a person of ordinary skill in the art "would have found it obvious to make an orientation of the PDA's user interface configurable responsive to a user input, for the sake of user convenience." Pet. 60; *see, e.g.*, Ex. 1003 ¶ 163.

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny, who testifies that the proposed modification would have allowed for easy activation of various functions. *See, e.g.*, Ex. 1003 ¶¶ 157–163. Patent Owner does not present any argument against this limitation, apart from the arguments already addressed in Section II.D.5.vii.

x. "[k] a storage device configured to at least temporarily store at least the measurements of the physiological parameter"

The cited evidence supports Petitioner's contention that Mendelson-2006 teaches that the PDA is configured to store vital medical information received from the wearable pulse oximeter, and that an ordinarily skilled artisan "would have understood that the vital medical information would have included measurements of the physiological parameters obtained by the physiological sensor device (e.g., SpO_2 and HR)." Pet. 60–61; Ex. 1010, 3

("The PDA can also serve to temporarily store vital medical information received from the wearable unit."); Ex. 1003 ¶ 166.

Petitioner further contends that, in light of these teachings, a person of ordinary skill in the art "would have found it obvious to configure a storage device of the PDA to at least temporarily store measurements of physiological parameters (e.g., SpO_2 and HR)." Pet. 61; *see, e.g.*, Ex. 1003 ¶ 166.

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 165–168. Patent Owner does not present any argument against this limitation, apart from the arguments already addressed in Section II.D.5.vii.

xi. Reasonable Expectation of Success

Patent Owner argues that Petitioner has failed to demonstrate a reasonable expectation of success because Dr. Kenny did not perform a design analysis to create a functional sensor. PO Resp. 55–56. We disagree. As discussed in detail above, each of Petitioner's proposed modifications to Mendelson-799—whether to include an opaque material with windows, as taught by Schulz; or to include a cover with a convex surface, as taught by Ohsaki; or to communicate with a handheld computing device, as taught by Mendelson-2006—is rooted in explicit teachings of the prior art, and is supported by persuasive declarant testimony.

We credit Dr. Kenny's testimony that, for each proposed modification, the combined prior art teachings would have been applied as known, to achieve predictable results. *See, e.g.*, Ex. 1003 ¶¶ 100 (applying

Ohsaki's teachings would have been "nothing more than the use of a known technique to improve similar devices in the same way, and combining prior art elements according to known methods to yield predictable results—improved adhesion of the sensor to the user's skin, and improved signal strength"), 109 (applying Schulz's teachings would have been "nothing more than the use of a known technique to improve similar devices in the same way, and combining prior art elements according to known methods to yield predictable results," i.e. to "avoid saturation"), 117 ("To obtain these and other advantages described by Mendelson-2006, a POSITA would have been motivated to wirelessly transmit information or data acquired or processed by sensor 10 and pulse oximeter 20 to a PDA".). For similar reasons discussed above with respect to each proposed modification, we conclude that that a skilled artisan would have had a reasonable expectation of success. *See supra* § II.D.5.iv, vi, vii; Ex. 1003 ¶¶ 89–168.

xii.Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

6. Independent Claim 21

Independent claim 21 consists of limitations that are substantially similar to elements [a]–[f] of claim 1. *Compare* Ex. 1001, 44:51–45:15, *with id.* at 46:31–49 (reciting that the convex surface is "located between tissue of the user and all of the at least four detectors," instead of "above all of the at least four detectors" as in claim 1; omitting details of the "handheld computing device"). In asserting that claim 21 also would have been

obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006, Petitioner refers to the same arguments presented as to claim 1. *See* Pet. 81–83; Ex. 1003 ¶¶ 206–212. Patent Owner relies on the same arguments discussed above regarding claim 1. PO Resp. 12–56.

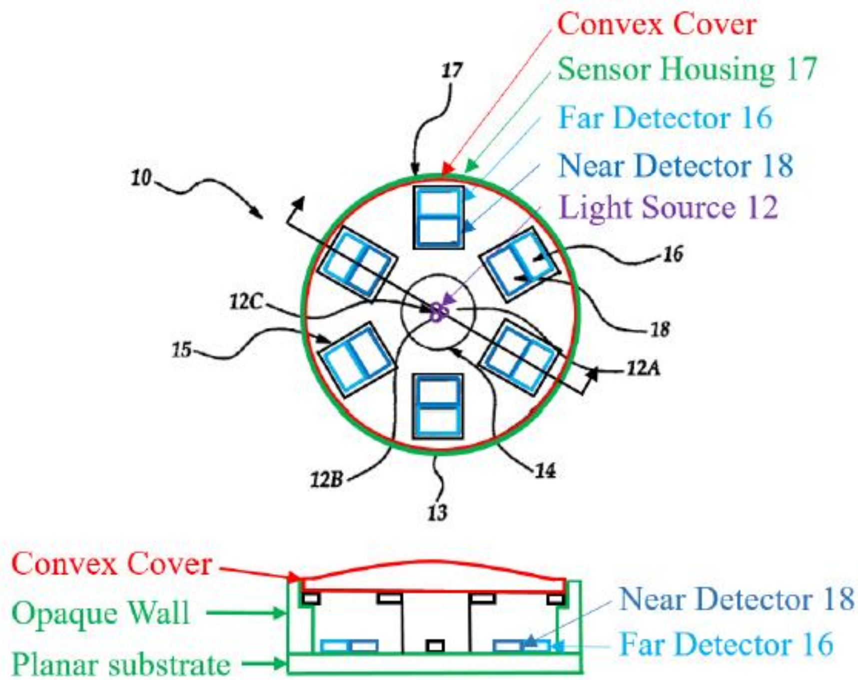
For the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 21 would have been obvious over the cited combination of references. *See supra* § II.D.5.

7. Dependent Claims 7 and 26

Dependent claim 7 ultimately depends from independent claim 1 and further recites, "the wall surrounds at least the at least four detectors on the first surface, the wall operably connects to the substrate on one side of the wall, and the wall operably connects to the cover on an opposing side of the wall." Ex. 1001, 45:40–47. Likewise, dependent claim 26 ultimately depends from independent claim 21 and further recites "the wall surrounds at least the at least four detectors on the first surface, wherein: the wall operably connects to the substrate on one side of the wall, and the wall operably connects to the cover on an opposing side of the wall." *Id.* at 47:12–48:5.

Petitioner contends that the sensor rendered obvious by the combined teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006 "would have included a wall surrounding the photodetectors, the wall being operably connected on one side to the substrate on which the detectors are arranged, and on an opposing side to a cover," as shown in Petitioner's annotated and modified view of Mendelson-799's Figure 7, as well as an added sectional view, both of which are reproduced below. Pet. 68–70 (citing, e.g., Ex. 1003

¶¶ 62–72, 89–100, 181); *see also id.* at 86 (regarding claim 26) (citing, e.g., Ex. 1003 ¶¶ 177–180, 221).



Petitioner's annotated and modified figures depict the sensor of Mendelson-799 with an added opaque wall illustrated in green and encircling the sensor components, and operably connected to the convex cover (illustrated in red) on the top and operably connected to the planar substrate of sensor housing 17 (illustrated in green) on the bottom.

Patent Owner argues that "Petitioner provides no independent analysis" for these claims and instead refers back to analyses of claims 1 and 21. PO Resp. 57. Patent Owner also argues that, in the annotated figures, Petitioner includes features not shown in the cited references, e.g., "a cover . . . spanning the entire space above the substrate" and a wall with "notches for the convex cover." *Id.* Patent Owner argues that "Petitioner cannot satisfy" the claims "by making unexplained changes to the cited art." *Id.* at

58. Moreover, Patent Owner argues that neither Ohsaki nor Mendelson-799 disclose a wall as claimed. *Id.*

As shown in the modified figures above, the wall of the combined sensor surrounds the sensor components and is operably connected to the convex cover on the top and is operably connected to the planar substrate on the bottom, as claimed. Moreover, as discussed above regarding claim 1, Petitioner's proposed modifications to Mendelson-799 are *not* premised upon bodily incorporating Ohsaki's cover directly with Mendelson-799's sensor. *See In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973) ("Combining the teachings of references does not involve an ability to combine their specific structures."). To the contrary, Petitioner proposes incorporating Ohsaki's *teaching* of a cover with a convex surface, not the precise cover and structure disclosed by Ohsaki. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981) ("[T]he test is what the combined teachings of those references would have suggested to those of ordinary skill in the art."). If Ohsaki's teaching is implemented in a manner that varies from the precise implementation of such a cover in Ohsaki, e.g., with a larger span or with notches, this is not a material deviation from Ohsaki's express teachings of using a cover with a convex surface to achieve specific benefits, e.g., improved adhesion and signal strength. Ex. 1009 ¶ 25; *see supra* § II.D.5.vi; *see Lear Siegler, Inc. v. Aeroquip Corp.*, 733 F.2d 881, 889 (Fed. Cir. 1984) (explaining that a person of ordinary skill is not "compelled to adopt every single aspect of [a reference] without the exercise of independent judgment").

Accordingly, for the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that

claims 7 and 26 would have been obvious over the cited combination of references.

8. Dependent Claim 29

Dependent claim 29 ultimately depends from independent claim 21 and further recites "the protruding convex surface protrudes a height greater than 2 millimeters and less than 3 millimeters." Ex. 1001, 48:14–16.

Petitioner contends that the sensor rendered obvious by the combined teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006 would have included a cover with a protruding convex surface. *See supra* § II.D.5.vi. With respect to claim 29, Petitioner incorporates its contentions regarding, *inter alia*, claims 12 and 18. Pet. 87 (incorporating, e.g., *id.* at 74–76); Ex. 1003 ¶¶ 89–100, 192–196, 224. In discussing claim 12, Petitioner contends that a person of ordinary skill in the art "would have found it obvious that a device designed to fit on a user's wrist would be on the order of millimeters," consistent with Ohsaki's disclosure that the device is in "intimate contact" with the user's skin. Pet. 75–76 (citing, e.g., Ex. 1003 ¶ 194). Petitioner also contends that an ordinarily skilled artisan would have taken user comfort into account when establishing the dimensions of the device's convex cover. *Id.* at 76. With these considerations in mind, Petitioner contends that, "in order to provide a comfortable cover featuring a protruding convex surface that prevents slippage, the surface should protrude a height between 1 millimeter and 3 millimeters," because "there would have been a finite range of possible protruding heights, and it would have been obvious to select a protruding height that would have been comfortable to the user." *Id.* (citing, e.g., Ex. 1003 ¶¶ 192–196).

Patent Owner argues that none of the cited references discloses the claimed height range and that Petitioner relies on hindsight reconstruction. PO Resp. 60–62 (citing, e.g., Ex. 2004 ¶¶ 104–107). Patent Owner also characterizes Dr. Kenny's testimony as conclusory and unsupported. *Id.* at 62.

Petitioner is correct that, "[w]hen there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product . . . of ordinary skill and common sense." *KSR*, 550 U.S. at 398. Petitioner has shown sufficiently that only a finite number of solutions existed with respect to the height of a convex protrusion on a tissue-facing sensor, which would have met the art-recognized goals of both (1) intimate contact between the sensor's surface and the user and (2) user comfort. *See, e.g.*, Ex. 1009 ¶¶ 6, 25. Bearing in mind these considerations, we credit Dr. Kenny's testimony that it would have been obvious, "in order to provide a comfortable cover featuring a protruding convex surface that prevents slippage, [that] the surface should protrude a height between 1 millimeter and 3 millimeters," which includes the claimed range of 2 to 3 millimeters. Ex. 1003 ¶ 195; Ex. 1047 ¶ 74. Further, the record does not support that any new and unexpected results were achieved at the claimed height greater than 2 millimeters and less than 3 millimeters.

We have considered Patent Owner's argument, and Dr. Madisetti's cited testimony. However, it is not dispositive that none of Mendelson-799, Ohsaki, Schulz, or Mendelson-2006 teach the claimed range. PO Resp. 60; Ex. 2004 ¶¶ 105. Petitioner relies upon the knowledge, ability, and

creativity of a person of ordinary skill in the art, not the teachings of a specific reference. Notably, Dr. Madisetti does not dispute Dr. Kenny's position that there were a finite number of options available for the height of the convex surface. Ex. 2004 ¶¶ 104–107. Therefore, we do not agree that Petitioner's contentions are rooted in impermissible hindsight. *See, e.g.*, *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971) ("Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made and does not include knowledge gleaned only from applicant's disclosure, such a reconstruction is proper.").

Accordingly, for the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 29 would have been obvious over the cited combination of references.

9. Dependent Claims 2–6, 8, 10–13, 15, 16, 20, 22–25, 27, and 28

Petitioner also contends that claims 2–6, 8, 10–13, 15, 16, 20, 22–25, 27, and 28 would have been obvious based on the same combination of prior art addressed above. These challenged claims all depend directly or indirectly from independent claim 1 or 21. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 62–81, 83–87. Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 169–205, 213–224.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claims 1

and 21. PO Resp. 56 ("The Petition fails to establish that independent claims 1 and 21 are obvious over the cited references of Ground 1 and therefore fails to establish obviousness of any of the challenged dependent claims."); *see supra* § II.D.5.

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–6, 8, 10–13, 15, 16, 20, 22–25, 27, and 28 would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, and Mendelson-2006, for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny.

10.Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 1–8, 10–13, 15, 16, and 20–29 would have been obvious over the cited combination of references.

E. Obviousness over the Combined Teachings of Mendelson-799, Ohsaki, Schulz, Mendelson-2006, and Bergey

Petitioner contends that claim 9 would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, Mendelson-2006, and Bergey. Pet. 88–90.

1. Overview of Bergey (Ex. 1016)

Bergey is a U.S. patent titled "Solid State Watch with Magnetic Setting," and discloses a watch in which the electronics are "hermetically sealed in the watch case to be free of dust and moisture." Ex. 1016,

code (57). Moreover, the electronic components are "resiliently mounted for improved shock resistance." *Id.*

Petitioner contends that it would have been obvious to have modified the sensor of Aizawa-Inokawa-Ohsaki-Mendelson-2006 to hermetically seal the sensor components within the substrate, wall, and cover, so as to obtain advantages disclosed by Bergey, e.g., to protect the electronics and prevent condensation within the case. Pet. 88–89 (citing Ex. 1003 ¶¶ 82–83, 225–228; Ex. 1016, code (57), 2:56–67, 8:48–9:34).

2. Analysis

Petitioner also contends that claim 9 would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, Mendelson-2006, and Bergey. Pet. 88–90. Claim 9 depends indirectly from independent claim 1. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of this claim, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. *Id.* Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 82–83, 225–228.

Patent Owner does not present any argument for this claim other than those we have already considered with respect to independent claim 1. PO Resp. 63 ("Bergey's alleged disclosure of a hermetically sealed watch does not fix the deficiencies identified for Ground 1."); *see supra* § II.D.

We have considered the evidence and arguments of record, including those directed to claim 1 and addressed above, and we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 9 would have been obvious over the combined teachings of Mendelson-799,

Ohsaki, Schulz, Mendelson-2006, and Bergey for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny. *See, e.g.*, Ex. 1016, 8:48–9:34; Ex. 1003 ¶¶ 225–228.

F. Obviousness over the Combined Teachings of Mendelson-799, Ohsaki, Schulz, Mendelson-2006, and Goldsmith

Dependent claim 14 ultimately depends from independent claim 1 and further recites, "the displayed indicia are further responsive to temperature." Ex. 1001, 46:4–6. Petitioner contends that claim 14 would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, Mendelson-2006, and Goldsmith. Pet. 90–94.

1. Overview of Goldsmith (Ex. 1011)

Goldsmith is a U.S. patent application publication titled "Watch Controller for a Medical Device," and discloses a watch controller device that communicates with an infusion device to "provid[e] convenient monitoring and control of the infusion pump device." Ex. 1011, codes (54), (57).

Goldsmith's Figure 9A and 9B are reproduced below.

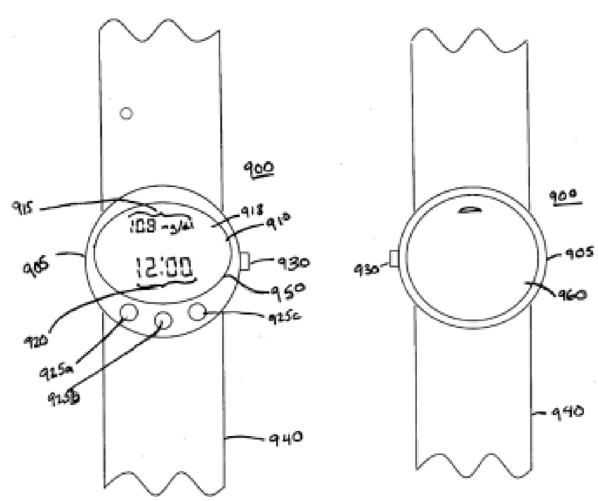


FIG.9A

FIG 9B

Figure 9A and Figure 9A are respective front and rear views of a combined watch and controller device. *Id.* ¶¶ 30–31. As shown in Figure 9A, watch controller 900 includes housing 905, transparent member 950, display 910, input devices 925a–c, scroll wheel 930, and wrist band 940. *Id.* ¶¶ 85–86. Figure 9B shows rear-side cover 960, and a rear view of housing 905, scroll wheel 930, and wrist band 940. *Id*.

Goldsmith discloses the watch controller may interact with one or more devices, such as infusion pumps or analyte monitors. *Id.* ¶ 85; *see also id.* ¶ 88 ("The analyte sensing device 1060 may be adapted to receive data from a sensor, such as a transcutaneous sensor."). Display 910 "may display at least a portion of whatever information and/or graph is being displayed on the infusion device display or on the analyte monitor display," such as, e.g., levels of glucose. *Id*. ¶ 86. The display is customizable in a variety of configurations including user-customizable backgrounds, languages, sounds, font (including font size), and wall papers. *Id*. ¶¶ 102, 104. Additionally, the watch controller may communicate with a remote station, e.g., a computer, to allow data downloading. *Id*. ¶ 89 (including wireless). The remote station may also include a cellular telephone to be "used as a conduit for remote monitoring and programming." *Id.*

2. Analysis

Petitioner contends that claim 14 would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, Mendelson-2006, and Goldsmith. Pet. 90–94. Claim 14 depends indirectly from independent claim 1. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of this claim, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of

ordinary skill in the art. *Id*. Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 84–85, 229–233.

Patent Owner does not present any argument for this claim other than those we have already considered with respect to independent claim 1. PO Resp. 63 ("Goldsmith's alleged disclosure of a temperature-responsive display does not fix the deficiencies identified for Ground 1."); *see supra* § II.D.

We have considered the evidence and arguments of record, including those directed to claim 1 and addressed above, and we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 14 would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, Mendelson-2006, and Goldsmith for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny. *See, e.g.*, Ex. 1011 ¶¶ 11, 87, 95, 102; Ex. 1003 ¶¶ 229–233.

G. Obviousness over the Combined Teachings of Mendelson-799, Ohsaki, Schulz, Mendelson-2006, and Aizawa

Petitioner contends that claims 17–19 would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, Mendelson-2006, and Aizawa. Pet.

1. Overview of Aizawa (Ex. 1006)

Aizawa is a U.S. patent application publication titled "Pulse Wave Sensor and Pulse Rate Detector," and discloses a pulse wave sensor that detects light output from a light emitting diode and reflected from a patient's artery. Ex. 1006, codes (54), (57).

Figure 1(a) of Aizawa is reproduced below.

FIG. 1 (a)

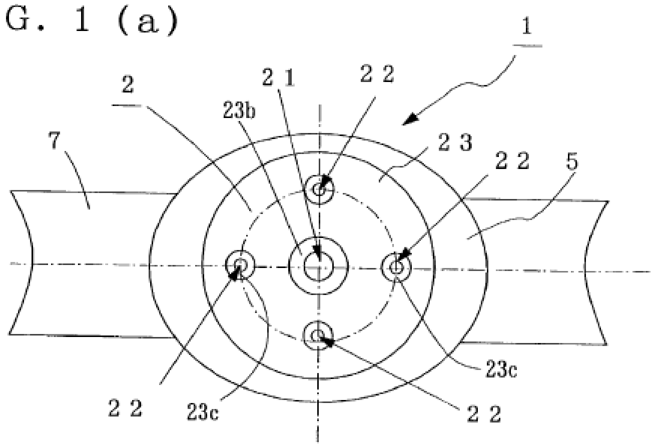


Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode ("LED") 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses that, "to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased." *Id.* ¶ 32, Fig. 4(a). "The same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector 22." *Id.* ¶ 33.

Figure 1(b) of Aizawa is reproduced below.

FIG. 1 (b)

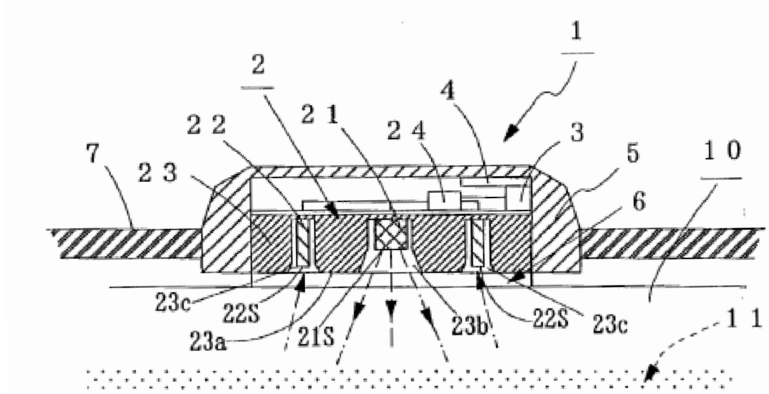


Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* ¶ 23. Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an "unshown display." *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.* ¶ 23.

Aizawa discloses that LED 21 and photodetectors 22 "are stored in cavities 23b and 23c formed in the detection face 23a" of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a "is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a." *Id.* ¶ 24. Aizawa discloses that "a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting face 21s of the light emitting diode 21 faces down (on the wrist 10 side)." *Id.* ¶ 26. Furthermore, "the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10. Thereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶¶ 26, 34.

2. Analysis of Claims 17 and 19

Claims 17 and 19 depend indirectly from independent claim 1. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of this claim, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in

the art. Pet. Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 86–88, 234–241.

Patent Owner does not present any substantive argument for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 63–64 ("Aizawa's alleged disclosure of a detector orientation does not fix the deficiencies identified for Ground 1."); *see supra* § II.D.

We have considered the evidence and arguments of record, including those directed to claim 1 and addressed above, and we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 17 and 19 would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, Mendelson-2006, and Aizawa for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny. *See, e.g.*, Ex. 1006 ¶¶ 23, 32, Figs. 1(a), 4(a), 7; Ex. 1003 ¶¶ 234–241.

3. Analysis of Claim 18

Claim 18 depends indirectly from independent claim 1 and further recites that the "convex surface protrudes a height greater than 2 millimeters and less than 3 millimeters," as also recited in claim 29, discussed above. Petitioner incorporates its contentions regarding, *inter alia*, claim 12. Pet. 99–100 (citing, e.g., Ex. 1003 ¶¶ 89–100, 192–196, 234–240).

Patent Owner does not present any argument for this claim other than those we have already considered with respect to independent claim 1 and dependent claim 29. PO Resp. 63–64.

We have considered the evidence and arguments of record, including those directed to claims 1 and 29 addressed above, and we determine that

Petitioner has demonstrated by a preponderance of the evidence that claim 18 would have been obvious over the combined teachings of Mendelson-799, Ohsaki, Schulz, Mendelson-2006, and Aizawa for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 192–196, 240; *see supra* § II.D.8.

III. CONCLUSION

In summary:[9]

Claims	**35 U.S.C. §**	**Reference(s)/ Basis**	**Claims Shown Unpatentable**	**Claims Not Shown Unpatentable**
1–8, 10–13, 15–16, 20–29	103	Mendelson-799, Ohsaki, Schulz, Mendelson-2006	1–8, 10–13, 15–16, 20–29	
9	103	Mendelson-799, Ohsaki, Schulz, Mendelson-2006, Bergey	9	
14	103	Mendelson-799, Ohsaki, Schulz, Mendelson-	14	

[9] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

		2006, Goldsmith		
17–19	103	Mendelson-799, Ohsaki, Schulz, Mendelson-2006, Aizawa	17–19	
Overall Outcome			1–29	

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–29 of the ’765 patent have been shown to be unpatentable; and

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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U.S. DEPARTMENT OF COMMERCE
UNITED STATES PATENT AND TRADEMARK OFFICE

May 23, 2022

THIS IS TO CERTIFY that the attached document is a list of the papers that comprise the record before the Patent Trial and Appeal Board (PTAB) for the *Inter Partes* Review proceeding identified below.

APPLE INC.,

Petitioner,

v.

MASIMO CORPORATION,

Patent Owner.

Case No.: IPR2020-01715
United States Patent No.: 10,631,765 B1

By authority of the
DIRECTOR OF THE UNITED STATES
PATENT AND TRADEMARK OFFICE

/s/ Mekbib Solomon
Certifying Officer

PROSECUTION HISTORY FOR *INTER PARTES* REVIEW NO.: IPR2020-01715

DATE	DESCRIPTION
09/30/2020	Petition for *Inter Partes* Review
09/30/2020	Petitioner's Power of Attorney
09/30/2020	Petitioner's Notice Ranking Petitions and Explaining Material Differences
10/15/2020	Notice of Filing Date Accorded
10/20/2020	Patent Owner's Mandatory Notices
01/08/2021	Petitioner's Updated Exhibit List
01/15/2021	Patent Owner's Notice of Waiver of Preliminary Response
04/13/2021	Decision - Institution of *Inter Partes* Review Proceeding
04/13/2021	Scheduling Order
04/27/2021	Patent Owner's Objections to Admissibility of Petitioner's Evidence Submitted Before Trial Institution
05/20/2021	Petitioner's Motion to File Supplemental Information
05/26/2021	Order Granting Petitioner's Motion to Submit Supplemental Information
06/01/2021	Petitioner's Submission of Supplemental Information
06/10/2021	Stipulation Modifying Due Dates
06/29/2021	Patent Owner's Notice of Deposition - Thomas W. Kenny
07/27/2021	Patent Owner's Response to Petition
07/27/2021	Patent Owner's Exhibit List
07/30/2021	Petitioner's Objections to Evidence
09/13/2021	Petitioner's Updated Mandatory Notice
11/09/2021	Petitioner's Reply to Patent Owner's Response
11/17/2021	Patent Owner's Objections to Admissibility of Evidence to Petitioner's Reply
12/03/2021	Petitioner's Oral Hearing Request
12/03/2021	Patent Owner's Request for Oral Argument
12/17/2021	Order Setting Oral Argument
12/17/2021	Patent Owner's Sur-Reply
12/17/2021	Patent Owner's Updated Exhibit List
01/06/2022	Patent Owner's Updated Mandatory Notice
01/14/2022	Petitioner's Updated Exhibit List
01/14/2022	Patent Owner's Demonstratives for Trial Hearing
02/16/2022	Oral Hearing Transcript
04/06/2022	Final Written Decision
04/12/2022	Notice of Appeal

Trials@uspto.gov
571-272-7822

Paper 33
Date: April 6, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

IPR2020-01715
Patent 10,631,765 B1

Before JOSIAH C. COCKS, ROBERT L. KINDER, and AMANDA F. WIEKER, *Administrative Patent Judges*.

WIEKER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

Apple Inc. ("Petitioner") filed a Petition requesting an *inter partes* review of claims 1–29 ("challenged claims") of U.S. Patent No. 10,631,765 B1 (Ex. 1001, "the '765 patent"). Paper 3 ("Pet."). Masimo Corporation ("Patent Owner") waived filing a preliminary response. Paper 7 ("PO Waiver"). We instituted an *inter partes* review of all challenged claims 1–29 on all grounds of unpatentability, pursuant to 35 U.S.C. § 314. Paper 8 ("Inst. Dec.").

After institution, Patent Owner filed a Response (Paper 17, "PO Resp.") to the Petition, Petitioner filed a Reply (Paper 21, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 26, "PO Sur-reply"). An oral hearing was held on January 19, 2022, and a transcript of the hearing is included in the record. Paper 32 ("Tr.").

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, Petitioner has met its burden of showing, by a preponderance of the evidence, that challenged claims 1–29 of the '765 patent are unpatentable.

B. Related Matters

The parties identify the following matters related to the '765 patent:

Masimo Corporation v. Apple Inc., Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

Apple Inc. v. Masimo Corporation, IPR2020-01714 (PTAB Sept. 30, 2020) (challenging claims 1–29 of the '765 patent);

Apple Inc. v. Masimo Corporation, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01713 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,624,564 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01716 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,702,194 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01722 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01723 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01733 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,195 B1); and

Apple Inc. v. Masimo Corporation, IPR2020-01737 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,709,366 B1).

Pet. 3–4; Paper 5, 1–4.

Patent Owner further identifies the following pending patent applications, among other issued and abandoned applications, that claim priority to, or share a priority claim with, the ’765 patent:

U.S. Patent Application No. 16/834,538;

U.S. Patent Application No. 16/449,143; and

U.S. Patent Application No. 16/805,605.

Paper 5, 1–2.

C. The ’765 Patent

The ’765 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on April 28, 2020, from U.S. Patent Application No. 16/725,478, filed December 23, 2019. Ex. 1001, codes (21), (22), (45), (54). The ’765 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The ’765 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:38–40. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:29–35, 64–65. The patient monitor includes a

display and a network interface for communicating with a handheld computing device. *Id.* at 2:45–48.

Figure 1 of the '765 patent is reproduced below.

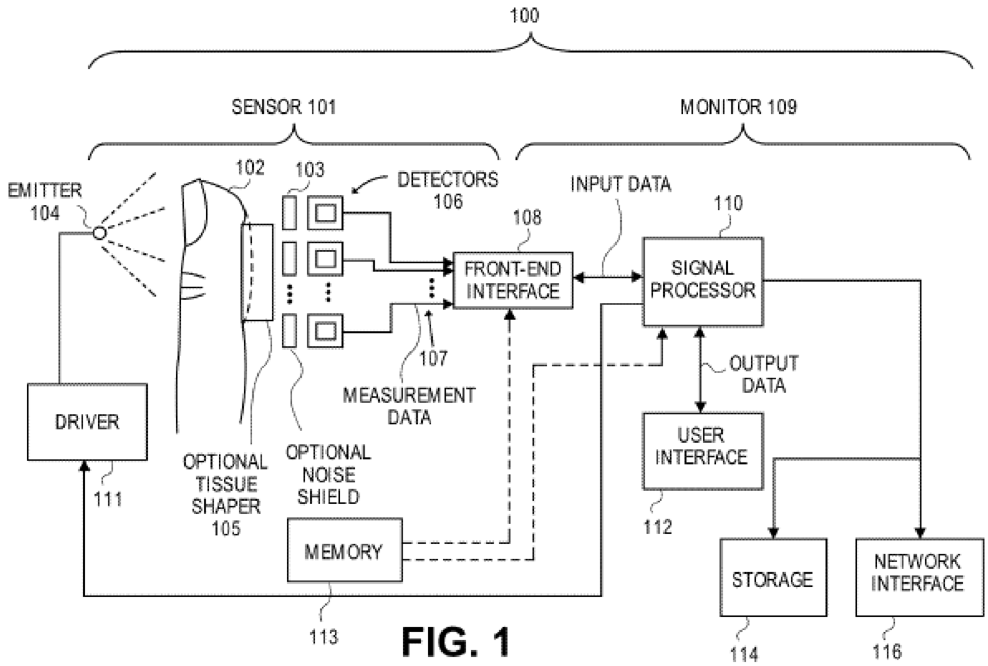

FIG. 1

Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:47–58. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* at 11:59–63. Emitters 104 emit light that is attenuated or reflected by the patient's tissue at measurement site 102. *Id.* at 14:3–7. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light, detectors 106 output detector signals 107 to monitor 109 through front-end interface 108. *Id.* at 14:7–10, 26–32. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 11:2–14.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:16–18. "[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals received from the detectors." *Id.* at 15:21–24. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:46–56. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 15:60–16:11.

The '765 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate detector portions of sensor devices.

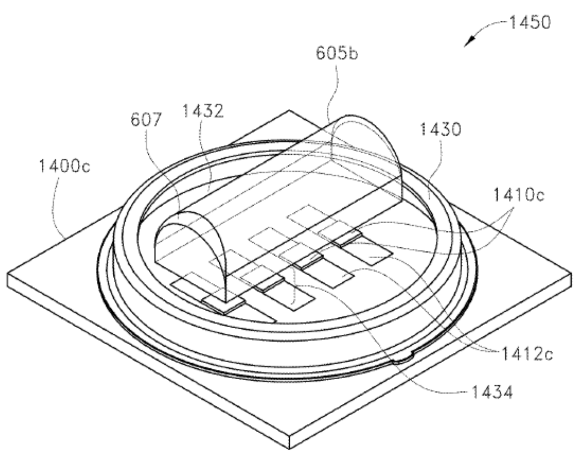

FIG. 14D

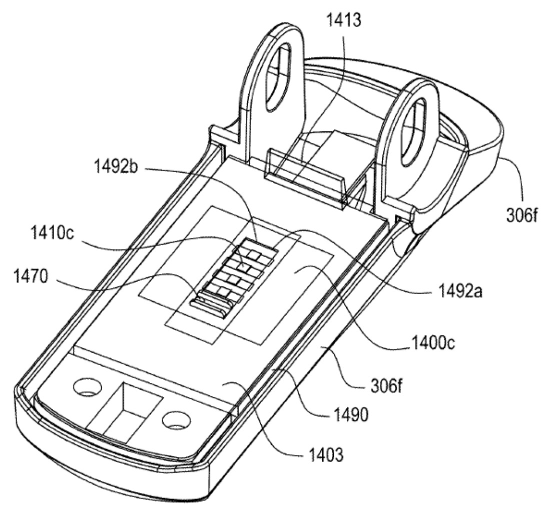

FIG. 14F

Figure 14D illustrates portions of a detector submount and Figure 14F illustrates portions of a detector shell. *Id.* at 6:44–47. As shown in Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 35:36–39, 36:30–37. Figure 14F illustrates a detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 37:9–17. Substrate 1400c is enclosed by shielding

enclosure 1490 and noise shield 1403, which include window 1492a and window 1492a, respectively, placed above detectors 1410c. *Id.* Alternatively, cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:47–48.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.

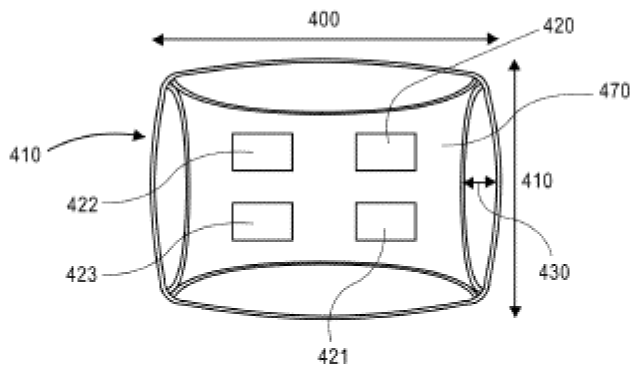

FIG. 4A

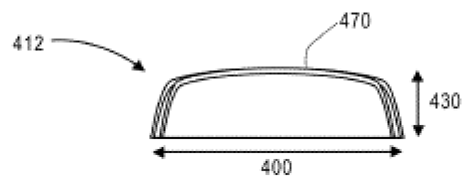

FIG. 4B

Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:18–24. "[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site." *Id.* "For example, . . . measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site." *Id.* at 23:39–43. The measurement site contact area may include windows 420–423 that "mimic or approximately mimic a configuration of, or even house, a plurality of detectors." *Id.* at 23:49–63.

D. Illustrative Claim

Of the challenged claims, claims 1 and 21 are independent. Claim 1 is illustrative and is reproduced below.

1. A physiological measurement system comprising:

[a] a physiological sensor device comprising:

[b] one or more emitters configured to emit light into tissue of a user;

[c] at least four detectors, wherein each of the at least four detectors has a corresponding window that allows light to pass through to the detector;

[d] a wall that surrounds at least the at least four detectors; and

[e] a cover comprising a protruding convex surface, wherein the protruding convex surface is above all of the at least four detectors, wherein at least a portion of the protruding convex surface is rigid, and wherein the cover operably connects to the wall; and

[f] a handheld computing device in wireless communication with the physiological sensor device, wherein the handheld computing device comprises:

[g] one or more processors configured to wirelessly receive one or more signals from the physiological sensor device, the one or more signals responsive to at least a physiological parameter of the user;

[h] a touch-screen display configured to provide a user interface, wherein:

[i] the user interface is configured to display indicia responsive to measurements of the physiological parameter, and

[j] an orientation of the user interface is configurable responsive to a user input; and

[k] a storage device configured to at least temporarily store at least the measurements of the physiological parameter.

Ex. 1001, 44:51–45:15 (bracketed identifiers a–k added). Independent claim 21 includes limitations substantially similar to limitations [a]–[f] of claim 1. *Id.* at 46:31–49.

E. Applied References

Petitioner relies upon the following references:

> Bergey, U.S. Patent No. 3,789,601, filed July 15, 1971, issued February 5, 1974 (Ex. 1016, "Bergey");
>
> Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1009, "Ohsaki");
>
> Aizawa, U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002 (Ex. 1006, "Aizawa");
>
> Inokawa et al., Japanese Patent Application Publication No. 2006-296564 A, filed April 18, 2005, published November 2, 2006 (Ex. 1007, "Inokawa");[1] and
>
> Y. Mendelson et al., "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," Proceedings of the 28th IEEE EMBS Annual International Conference, 912–915 (2006) (Ex. 1010, "Mendelson-2006").

Pet. 10.

Petitioner also submits, *inter alia*, the Declaration of Thomas W. Kenny, Ph.D. (Ex. 1003), and the Second Declaration of Thomas W. Kenny (Ex. 1047). Patent Owner submits, *inter alia*, the Declaration of Vijay K. Madisetti, Ph.D. (Ex. 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madisetti, including from this proceeding and others. *See* Exs. 1052–1054, 2006–2009, 2027.

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[1] Petitioner relies on a certified English translation of Inokawa (Ex. 1008). In this Decision, we also refer to the translation.

F. Asserted Grounds of Unpatentability

We instituted an *inter partes* review based on the following grounds.

Claim(s) Challenged	35 U.S.C. §	References/Basis
1–8, 10–13, 15–29	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006
9	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006, Bergey
14	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006, Goldsmith

II. DISCUSSION

A. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2019). Petitioner submits that no claim term requires express construction. Pet. 9. Patent Owner submits that claim terms should be given their ordinary and customary meaning, consistent with the Specification. PO Resp. 9.

We agree that no claim terms require express construction. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

B. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103(a) if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406

(2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness.[2] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must support its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

Petitioner identifies the appropriate level of skill in the art as that possessed by a person with "a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software

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[2] Patent Owner has not presented objective evidence of non-obviousness.

technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information." Pet. 9 (citing Ex. 1003 ¶¶ 20–21). "Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline." *Id.*

Patent Owner makes several observations regarding Petitioner's identified level of skill in the art but, "[f]or this proceeding, [Patent Owner] nonetheless applies Petitioner's asserted level of skill." PO Resp. 9–10 (citing Ex. 2004 ¶¶ 32–35).

We adopt Petitioner's assessment as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

D. Obviousness over the Combined Teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006

Petitioner contends that claims 1–8, 10–13, and 15–29 of the '765 patent would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006. Pet. 11–93; *see generally* Pet. Reply. Patent Owner disagrees. PO Resp. 11–66; *see generally* PO Sur-reply.

Based on our review of the parties' arguments and the cited evidence of record, we determine that Petitioner has met its burden of showing by a preponderance of evidence that claims 1–8, 10–13, and 15–29 are unpatentable.

1. Overview of Aizawa (Ex. 1006)

Aizawa is a U.S. patent application publication titled "Pulse Wave Sensor and Pulse Rate Detector," and discloses a pulse wave sensor that

detects light output from a light emitting diode and reflected from a patient's artery. Ex. 1006, codes (54), (57).

Figure 1(a) of Aizawa is reproduced below.

FIG. 1 (a)

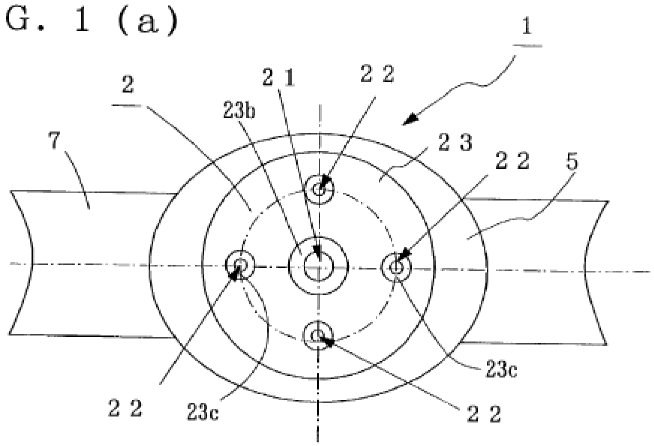

Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode ("LED") 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses that, "to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased." *Id.* ¶ 32, Fig. 4(a). "The same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector 22." *Id.* ¶ 33.

Figure 1(b) of Aizawa is reproduced below.

FIG. 1 (b)

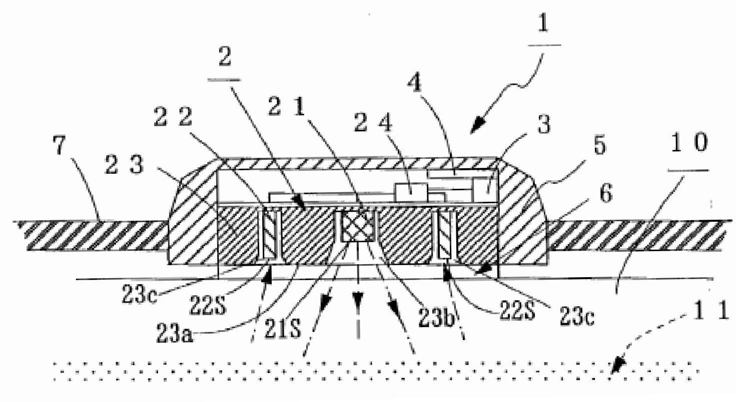

Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* ¶ 23. Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an "unshown display." *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.* ¶ 23.

Aizawa discloses that LED 21 and photodetectors 22 "are stored in cavities 23b and 23c formed in the detection face 23a" of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a "is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a." *Id.* ¶ 24. Aizawa discloses that "a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting face 21s of the light emitting diode 21 faces down (on the wrist 10 side)."

Id. ¶ 26. Furthermore, "the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10. Thereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶¶ 26, 34.

2. Overview of Inokawa (Ex. 1007)

Inokawa is a Japanese published patent application titled "Optical Vital Sensor, Base Device, Vital Sign Information Gathering System, and Sensor Communication Method," and discloses a pulse sensor device. Ex. 1008 ¶ 6.

Figure 1 of Inokawa is reproduced below.

(FIG. 1)

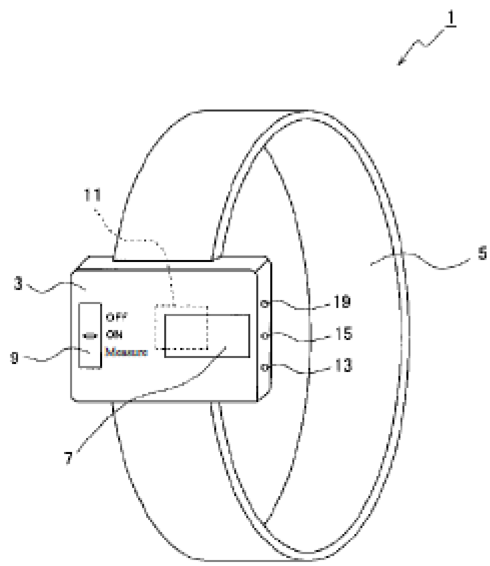

Figure 1 illustrates a schematic view of a pulse sensor. *Id.* ¶ 56. Pulse sensor 1 includes box-shaped sensor unit 3 and flexible annular wristband 5. *Id.* ¶ 57. Sensor unit 3 includes a top surface with display 7 and control switch 9, and a rear surface (sensor-side) with optical device component 11 for optically sensing a user's pulse. *Id.*

Figure 2 of Inokawa is reproduced below.

(FIG. 2)

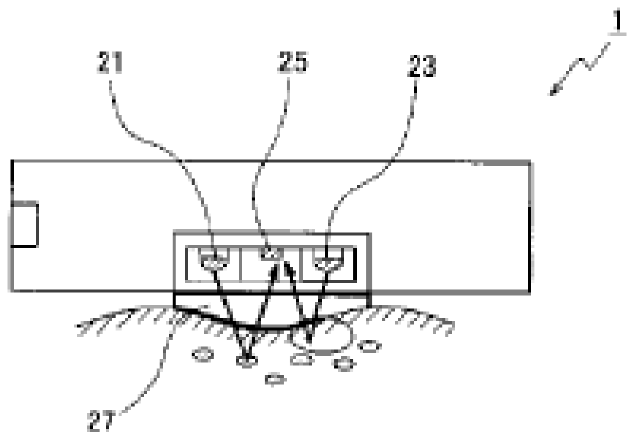

Figure 2 illustrates a schematic view of the rear surface of the pulse sensor. *Id.* ¶ 58. The rear-side (sensor-side) of pulse sensor 1 includes a pair of light-emitting elements, i.e., green LED 21 and infrared LED 23, as well as photodiode 25 and lens 27. *Id.* In various embodiments, Inokawa discloses that the sensor-side lens is convex. *See id.* ¶¶ 99, 107. Green LED 21 is used to sense "the pulse from the light reflected off of the body (i.e.[,] change in the amount of hemoglobin in the capillary artery)," and infrared LED 23 is used to sense body motion from the change in reflected light. *Id.* ¶ 59. The pulse sensor stores this information in memory. *Id.* ¶ 68. To read and store information, the pulse sensor includes a CPU that "performs the processing to sense pulse, body motion, etc. from the signal . . . and temporarily stores the analysis data in the memory." *Id.* ¶ 69.

Figure 3 of Inokawa is reproduced below.

(FIG. 3)

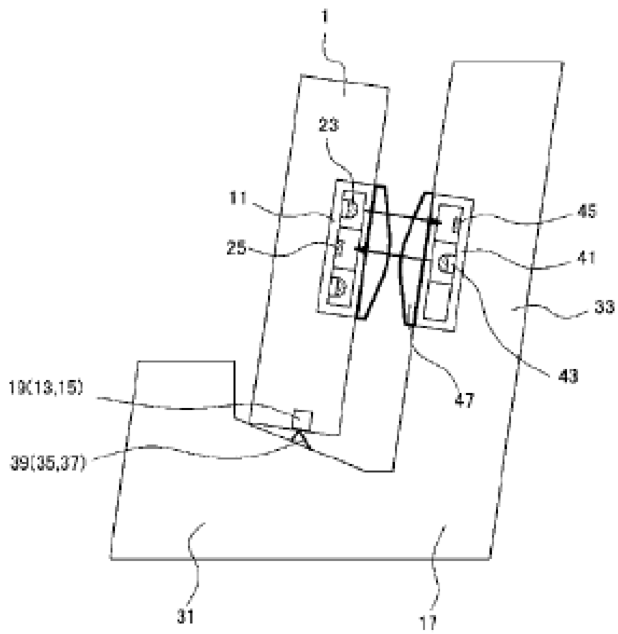

Figure 3 illustrates a schematic view of a pulse sensor mounted to a base device. *Id.* ¶ 60. Pulse sensor 1 is depicted as mounted to base device 17, which "is a charger with communication functionality." *Id.* When so mounted, sensor optical device component 11 and base optical device component 41 face each other in close proximity. *Id.* ¶ 66. In this position, pulse sensor 1 can output information to the base device through the coupled optical device components. *Id.* ¶ 67. Specifically, the pulse sensor CPU performs the controls necessary to transmit pulse information using infrared LED 23 to photodetector 45 of base device 17. *Id.* ¶¶ 67, 70, 76. In an alternative embodiment, additional sensor LEDs and base photodetectors can be used to efficiently transmit data and improve accuracy. *Id.* ¶ 111.

3. Overview of Ohsaki (Ex. 1009)

Ohsaki is a U.S. patent application publication titled "Wristwatch-type Human Pulse Wave Sensor Attached on Back Side of User's Wrist," and

discloses an optical sensor for detecting a pulse wave of a human body. Ex. 1009, code (54), ¶ 3. Figure 1 of Ohsaki is reproduced below.

FIG. 1

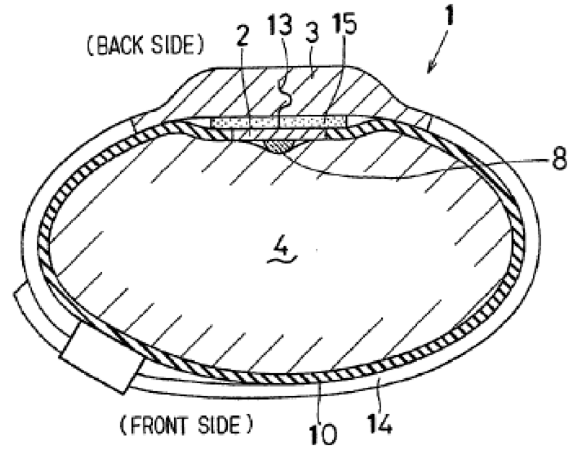

Figure 1 illustrates a cross-sectional view of pulse wave sensor 1 attached on the back side of user's wrist 4. *Id.* ¶¶ 12, 16. Pulse wave sensor 1 includes detecting element 2 and sensor body 3. *Id.* ¶ 16.

Figure 2 of Ohsaki, reproduced below, illustrates further detail of detecting element 2.

FIG. 2

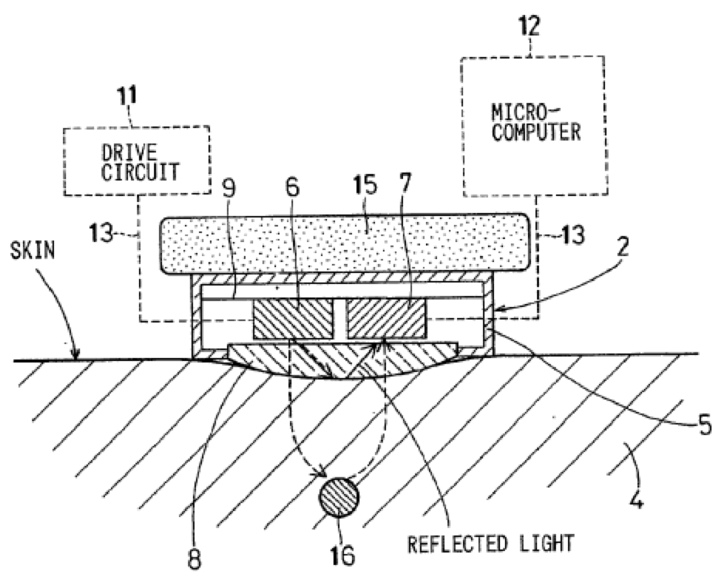

Figure 2 illustrates a mechanism for detecting a pulse wave. *Id.* ¶ 13. Detecting element 2 includes package 5, light emitting element 6, light receiving element 7, and translucent board 8. *Id.* ¶ 17. Light emitting element 6 and light receiving element 7 are arranged on circuit board 9 inside package 5. *Id.* ¶¶ 17, 19.

"[T]ranslucent board 8 is a glass board which is transparent to light, and attached to the opening of the package 5. A convex surface is formed on the top of the translucent board 8." *Id.* ¶ 17. "[T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin," preventing detecting element 2 from slipping off the detecting position of the user's wrist. *Id.* ¶ 25. By preventing the detecting element from moving, the convex surface suppresses "variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin." *Id.* Additionally, the convex surface prevents penetration by "noise such as disturbance light from the outside." *Id.*

Sensor body 3 is connected to detecting element 2 by signal line 13. *Id.* ¶ 20. Signal line 13 connects detecting element 2 to drive circuit 11, microcomputer 12, and a monitor display (not shown). *Id.* Drive circuit 11 drives light emitting element 6 to emit light toward wrist 4. *Id.* Detecting element 2 receives reflected light which is used by microcomputer 12 to calculate pulse rate. *Id.* "The monitor display shows the calculated pulse rate." *Id.*

4. Mendelson-2006 (Ex. 1010)

Mendelson-2006 is a journal article titled "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," and discloses a

wireless wearable pulse oximeter connected to a personal digital assistant ("PDA"). Ex. 1010, 1.[3]

Figure 1 of Mendelson-2006 is reproduced below.

Figure 1 illustrates a sensor module attached to the skin (top), and a photograph of a disassembled sensor module and receiver module (bottom). The sensor module includes an optical transducer, a stack of round printed circuit boards, and a coin cell battery. *Id.* at 2.

[3] Petitioner cites to the page numbers added to Exhibit 1010, rather than the native page numbering that accompanies the article. *See, e.g.*, Pet. 20–22. We follow Petitioner's numbering scheme.

Figure 2 of Mendelson-2006 is reproduced below.

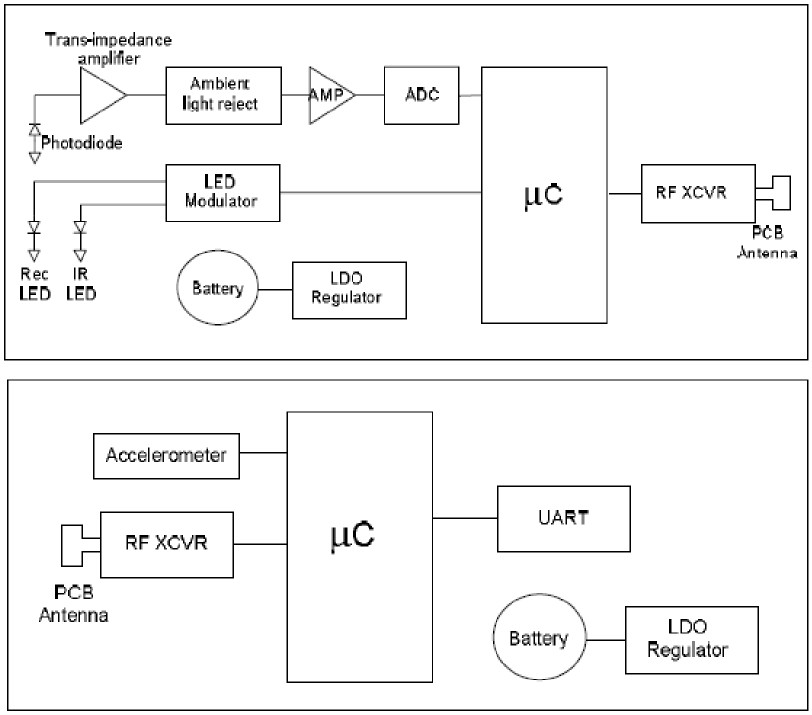

Figure 2 depicts a system block diagram of the wearable, wireless, pulse oximeter including the sensor module (top) and the receiver module (bottom). *Id.* The sensor module includes at least one light-emitting diode ("LED"), a photodetector, signal processing circuitry, an embedded microcontroller, and an RF transceiver. *Id.* at 1–2. Mendelson-2006 discloses that a concentric array of discrete photodetectors could be used to increase the amount of backscattered light detected by a reflectance type pulse oximeter sensor. *Id.* at 4. The receiver module includes an embedded microcontroller, an RF transceiver for communicating with the sensor module, and a wireless module for communicating with the PDA. *Id.* at 2.

As a PDA for use with the system, Mendelson-2006 discloses "the HP iPAQ h4150 PDA because it can support both 802.11b and Bluetooth™ wireless communication" and "has sufficient computational resources." *Id.* at 3. Mendelson-2006 further discloses that

> [t]he use of a PDA as a local terminal also provides a low-cost touch screen interface. The user-friendly touch screen of the PDA offers additional flexibility. It enables multiple controls to occupy the same physical space and the controls appear only when needed. Additionally, a touch screen reduces development cost and time, because no external hardware is required. . . . The PDA can also serve to temporarily store vital medical information received from the wearable unit.

Id.

The PDA is shown in Figure 3 of Mendelson-2006, reproduced below.

Figure 3 illustrates a sample PDA and its graphical user interface ("GUI"). *Id.* Mendelson-2006 explains that the GUI allows the user to interact with the wearable system. *Id.* "The GUI was configured to present the input and output information to the user and allows easy activation of various functions." *Id.* "The GUI also displays the subject's vital signs, activity level, body orientation, and a scrollable PPG waveform that is transmitted by the wearable device." *Id.* For example, the GUI displays numerical oxygen saturation ("SpO_2") and heart rate ("HR") values. *Id.*

5. Independent Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006. Pet. 11–62. Below, we set forth how the combination of prior art references teaches or suggests the claim limitations that are not disputed by the parties. For those limitations and reasons for combining the references that are disputed, we examine each of the parties' contentions and then provide our analysis.

i. "A physiological measurement system comprising"

The cited evidence supports Petitioner's undisputed contention that Aizawa satisfies the subject matter of the preamble.[4] Pet. 38; *see, e.g.*, Ex. 1006 ¶ 2 ("The present invention relates to a pulse wave sensor for detecting the pulse wave of a subject.").

ii. "[a] a physiological sensor device comprising"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses a physiological sensor device including a pulse rate detector. Pet. 38–41; *see, e.g.*, Ex. 1006 ¶ 23 (pulse wave sensor 2), Figs. 1(a)–(b).

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[4] Whether the preamble is limiting need not be resolved because Petitioner shows sufficiently that the preamble's subject matter is satisfied by the art.

iii. "[b] one or more emitters configured to emit light into tissue of a user"

Petitioner's Undisputed Contentions

Petitioner contends that Aizawa discloses one emitter—LED 21—and also states that, in certain embodiments, multiple LEDs may be employed. Pet. 11, 20–21. Patent Owner does not dispute this contention, and we agree with Petitioner that Aizawa discloses "one or more emitters" as claimed. *See* Ex. 1006 ¶¶ 23 ("LED 21"), 32 ("The arrangement of the light emitting diode 21 and the photodetectors 22 is not limited to this."). For example, Aizawa explains that "[t]he same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector." *Id.* ¶ 33.

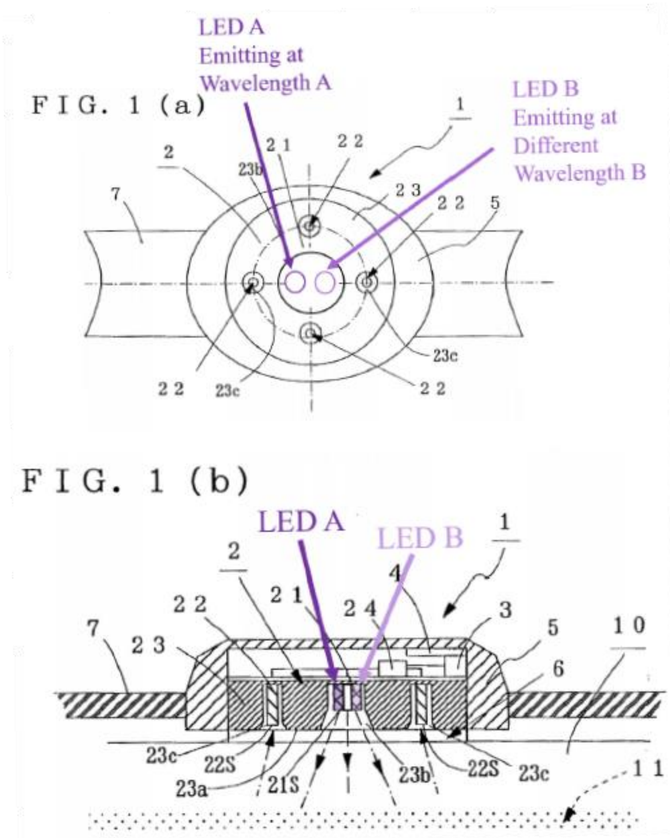
Petitioner also contends that Inokawa teaches a sensor with two LEDs–a green LED to sense pulse and an infrared LED to sense body motion. Pet. 14, 20. Petitioner also contends that when Inokawa's sensor is mounted on a base device, the infrared LED also is used to wirelessly transmit vital information to the base device. *Id.* at 14–15, 20–21. Patent Owner does not dispute these contentions, and we agree with Petitioner. Inokawa teaches a pair of LEDs 21, 23, where "the basic function of the S-side green LED 21 is to sense the pulse from the light reflected off of the body . . ., while the S-side infrared LED 23 serves to sense body motion from the change in this reflected light." Ex. 1008 ¶¶ 58–59. Inokawa also explains that "vital sign information stored in the memory 63 [of the sensor], such as pulse and body motion, is transmitted to the base device 17 using the S-side infrared LED 23 of the pulse sensor 1 and the B-side PD 45 of the base device 17," such that "there is no need to use a special wireless communication circuit or a communication cable." *Id.* ¶¶ 76–77.

Petitioner's Disputed Contentions

Moreover, Petitioner contends that a person of ordinary skill in the art would have been motivated to modify Aizawa "to include an additional LED as taught by Inokawa to improve the detected pulse wave by distinguishing between blood flow detection and body movement." Pet. 20, 42–43. According to Dr. Kenny, "[i]n this manner, Aizawa's sensor is improved by using a separate LED to account for motion load that the system already records and accounts for." Ex. 1003 ¶ 85.

As a second and independent motivation, Petitioner also contends that such a modification also would have provided "additional functionality, including that of a wireless communication method," which would have "eliminate[d] problems associated with a physical cable, and, as taught by Inokawa, without requiring a separate RF circuit." Pet. 20–21. Petitioner contends that although Aizawa discloses data transmission, Aizawa "is silent about how such transmission would be implemented." *Id.* at 21. According to Petitioner, a skilled artisan "would have recognized that Aizawa's LED could have been used for wireless data communication with a personal computer to eliminate problems associated with a physical cable, and, as taught by Inokawa, without requiring a separate RF," which "would result in enhanced accuracy of the transmitted information." *Id.* According to Dr. Kenny, "the LEDs provided on the sensor can be used not only to detect pulse rate but also to 'accurately, easily, and without malfunction' transmit sensed data to a base station." Ex. 1003 ¶ 81.

To illustrate its proposed modification, Petitioner includes annotated and modified views of Aizawa's Figures 1(a) and 1(b), reproduced below. Pet. 22; *see also id.* at 42 (similar figures); Ex. 1003 ¶ 84.



Petitioner's annotated and modified figures depict the sensor of Aizawa with an added "LED B" (illustrated in light purple), as Petitioner contends would have been rendered obvious by Inokawa. *Id.* at 22, 42; Ex. 1003 ¶¶ 79–87, 109–110.

<u>Patent Owner's Arguments</u>

Patent Owner disputes Petitioner's contentions regarding the obviousness of modifying Aizawa to include two emitters. *See* PO Resp. 50–57; Sur-reply 23–25.

First, Patent Owner argues that neither Aizawa nor Inokawa discloses a device with both multiple detectors *and* multiple emitters in the *same* sensor, because Aizawa's embodiments have either a single emitter and multiple detectors (e.g., Ex. 1006, Fig. 1(a)) or multiple emitters and a single

detector (e.g., *id.* ¶ 33), and Inokawa discloses multiple emitters and a single detector (e.g., Ex. 1008, Fig. 2). *See* PO Resp. 50–51 (citing, e.g., Ex. 1006 ¶ 33, Figs. 1, 2, 4, 5; Ex. 1008 ¶ 58, Fig. 2; Ex. 2004 ¶¶ 100–102). Patent Owner concludes, therefore, that there would have been no reason for a person of ordinary skill in the art to add a second emitter to Aizawa, when Aizawa already discloses an embodiment with multiple LEDs, i.e., an embodiment with only a single detector. PO Resp. 51 (citing, e.g., Ex. 2004 ¶ 103).

Second, Patent Owner argues that the evidence does not support either of Petitioner's two proffered motivations for modifying Aizawa to include two emitters. As to the first motivation (to measure body movement using a second emitter), Patent Owner asserts that Dr. Kenny erroneously testifies that Aizawa cannot do this with its single emitter. PO Resp. 51–52 (citing, e.g., Ex. 1006 ¶ 15; Ex. 2007, 400:7–401:10; Ex. 2004 ¶ 104). Patent Owner argues that "Petitioner admits that Aizawa's sensor 'already records and accounts for' motion load." *Id.* at 52 (citing, e.g., Pet. 20, 23; Ex. 1006 ¶ 28). Thus, Patent Owner contends that the proposed motivation would not realize an improvement over Aizawa alone. *Id.*

As to Petitioner's second motivation (to enable transmission of data to a base device using an optical communication link), Patent Owner argues that "Aizawa ***already*** includes a wireless transmitter . . . so Aizawa does not need to incorporate Inokawa's base-device [optical] data transmission arrangement." PO Resp. 53 (citing, e.g., Ex. 1006 ¶¶ 23, 28, 35; Ex. 2004 ¶¶ 105–106). Indeed, Patent Owner argues "Dr. Kenny acknowledged Aizawa identifies no problems with Aizawa's form of data transmission." *Id.* (citing Ex. 2007, 409:13–410:2). Patent Owner further argues that

"Aizawa's goal is 'real-time measuring' with the transmitter 'transmitting the measured pulse rate data to a display'" but that "Inokawa's data transfer approach does ***not*** allow real-time display of measurements." *Id.* at 53–54 (citing, e.g., Ex. 1006 ¶¶ 4, 15; Ex. 1008 ¶¶ 70, 74; Ex. 2004 ¶ 107). Patent Owner insists Inokawa does not aid Petitioner's case, because Inokawa discloses the benefits of using a second emitter in only two situations, i.e., first, to improve over a "mechanically-connected system," e.g., with a cable for communication, and, second, to avoid use of a "dedicated wireless communication circuit," whereas "Aizawa ***already*** incorporates a transmitter into its design." *Id.* at 54–55 (citing, e.g., Ex. 1008 ¶ 4; Ex. 1006 ¶¶ 16, 23, 28, 35; Ex. 2004 ¶ 108).

Third, Patent Owner accuses Petitioner and Dr. Kenny of overlooking further complications that would ensue from modifying Aizawa to have two emitters. Patent Owner argues that Dr. Kenny overlooked how placing "two LEDs in close proximity may cause thermal interference that could create significant issues for sensor performance," and would require "structural changes" to Aizawa's configuration. PO Resp. 56 (citing, e.g., Ex. 2004 ¶¶ 109–110; Ex. 1019, 76–77). Patent Owner also argues that "Petitioner widened Aizawa's emitter cavity to accommodate the extra LED with ***no*** explanation or recognition of this change," which could impact optical performance of the device. *Id.* at 56–57 (citing, e.g., Ex. 2004 ¶¶ 109–111).

<u>Petitioner's Reply</u>

Concerning Petitioner's first motivation, Petitioner asserts that adding an additional LED enables the sensor to distinguish between blood flow and body movement, which provides a "more reliable" pulse measurement, which is Petitioner's asserted improvement to Aizawa. Pet. Reply 34

(citing, e.g., Ex. 1003 ¶¶ 79–86; Ex. 2007, 401:11–402:4; Ex. 1047 ¶ 70). Moreover, Petitioner contends that by using multiple LEDs at different wavelengths, "two separate signals" can be collected, which "allows noise arising from body motion to be better isolated and accounted for." *Id.* (citing Ex. 1047 ¶ 70).

Concerning Petitioner's second motivation, Petitioner maintains that Inokawa's use of two emitters having different wavelengths to upload data to a base device using optical communication advantageously improves the accuracy of the transmission by providing checksum information. *Id.* at 34–35 (citing, e.g., Ex. 1003 ¶ 70; Ex. 1008 ¶ 111; Ex. 2007, 407:7–408:20, 416:5–15; Ex. 1047 ¶ 71).

As to the "other complications" that Patent Owner alleges would result from the proposed modification, Petitioner asserts "such issues are 'part of what [a person of ordinary skill in the art] would bring . . . to the problem and would know how to make the changes needed.'" *Id.* at 35 (quoting Ex. 2007, 384:8–388:12; Ex. 1047 ¶ 72).

<u>Patent Owner's Sur-reply</u>

Concerning Petitioner's first motivation, Patent Owner argues that Inokawa's disclosure is just as sparse as Aizawa's disclosure regarding how to use optical data to measure body movement. Sur-reply 24 (citing Ex. 1008 ¶ 59). Patent Owner also asserts that "Petitioner cites nothing in Inokawa that suggests" that Inokawa's two emitter data gathering is more reliable or otherwise superior to Aizawa's single emitter data gathering. *Id.*

Concerning Petitioner's second motivation, Patent Owner argues that the proposed modification eliminates Aizawa's ability to conduct "***real-time***

collection and display of physiological measurements—a key goal of Aizawa's system." *Id.* at 24–25.

Patent Owner also notes that Petitioner does not dispute that the proposed modification would cause problems such as "additional cost, energy use, and thermal problems" that would ensue from using two emitters in the Aizawa device. *Id.*

Analysis

Upon review of the foregoing, we conclude a preponderance of the evidence supports Petitioner's contention that it would have been obvious to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, in light of Inokawa.

First, a person of ordinary skill in the art would have been motivated to make this replacement to improve the pulse measurements recorded by Aizawa's detector 1. Inokawa teaches that the infrared LED's signal can be used "to detect vital signs" such as "body motion," and the green LED's signal can be "used to detect pulse." Ex. 1008, Fig. 2, ¶¶ 14, 58–59; Ex. 1003 ¶¶ 68, 80, 83–85; Ex. 1047 ¶¶ 69–70.

Patent Owner correctly points out that Aizawa describes its single-emitter detector 1 as transmitting its pulse data to "a device for computing the amount of motion load from the pulse rate." Ex. 1006 ¶¶ 15, 28, 35. But, this description is the only disclosure in Aizawa cited by Patent Owner as relating to computing a motion characteristic of the user. Further, we are unable to discern any other disclosure in Aizawa relating to motion computation, or what Aizawa proposes to do with its motion computation. *See id.* Based on the sparse nature of Aizawa's disclosure concerning motion load, it is not clear exactly what Aizawa proposes to do with the

computed motion load, after it is computed. *See, e.g.*, Ex. 1047 ¶ 70 ("Aizawa is silent on whether it uses the computed motion load to improve the detection signal."). Aizawa does, however, describe the motion load as being computed "from the pulse rate," rather than being an input to the pulse rate calculation. Ex. 1006 ¶¶ 15, 35.

In a deposition for other proceedings related to this *inter partes* review, *see supra* § I.B, Dr. Kenny was asked whether it was his understanding that "Aizawa's sensor could not account for motion load?"; Dr. Kenny answered that "Aizawa's sensor attempts to prevent motion load rather than account for it." Ex. 2007, 400:7–11 (deposition for IPR2020-01520, IPR2020-01537, and IPR2020-01539). He explained that, because Aizawa uses only a single emitter with a single wavelength, "what [Aizawa] sees as a signal would be some mixture of pulse rate and motion load if there was no effort to prevent motion load," so Aizawa seeks to solve the problem of "prevent[ing] motion load from corrupting the pulse rate signal." *Id.* at 400:12–401:10. Dr. Kenny did not further explain this distinction between preventing and accounting for motion load in his deposition testimony cited by the parties as relating to this issue. *Id.* at 400:7–402:4. We do not rely on this distinction as a basis for our present decision, because we find no express support for it in Aizawa's disclosure (*see* Ex. 1006 ¶¶ 15, 28, 35), and it is not explained in persuasive detail by Dr. Kenny.

We nonetheless credit Dr. Kenny's declaration testimony that a person of ordinary skill in the art, upon reviewing Inokawa's disclosure of using two emitters of different wavelengths to calculate a user's pulse and motion separately, would understand that these two separate measurements would enable the device to calculate a "more reliable" pulse rate because it "allows

noise arising from body motion to be better isolated and accounted for." Ex. 1047 ¶ 70; Ex. 1003 ¶¶ 80, 83, 85, 109–110. Aizawa does not disclose using the computed motion load in this fashion, so it appears that this would improve upon the accuracy of Aizawa's pulse measurements, by using the computed motion load to isolate and account for noise. *See* Ex. 1006 ¶¶ 15, 28, 35.

Dr. Madisetti also offers no meaningful opposing testimony in this regard. *See, e.g.*, Ex. 2004 ¶ 104. Instead, Dr. Madisetti incorrectly reads Dr. Kenny's motivation testimony as being limited to the desirability of adding the bare ability to measure body movement to Aizawa. *See id.* In fact, Dr. Kenny further testified that it would have been beneficial to *use* the measured body movement to *improve* the pulse measurement of the device. *See* Ex. 1003 ¶¶ 80, 83, 85; Ex. 1047 ¶ 70. Dr. Madisetti does not address that testimony. *See* Ex. 2004 ¶ 104.

Thus, because Dr. Madisetti's testimony sets up a straw man to attack, rather than directly addressing the entirety of Dr. Kenny's testimony in this regard, Dr. Kenny's testimony stands unrebutted in the record before us. Dr. Kenny's testimony also makes intuitive sense that measuring the user's motion *separately* from the user's pulse, for example by using two interrogating emitters of two different wavelengths, would provide a reliable means of correcting the pulse data for motion artifacts by using the separately measured motion data, rather than by trying to segregate these two components in the single data stream provided by Aizawa's single emitter device. *See, e.g.*, Ex. 1047 ¶ 70. We, therefore, are persuaded by Dr. Kenny's unrebutted testimony that using two emitters of different wavelengths would improve Aizawa's device in this way.

Independently, we are also persuaded that a person of ordinary skill in the art would have been motivated to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, to provide a reliable method of uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for display to the user. Inokawa expressly touts such optically-based uploading of data from Inokawa's wrist-worn sensor 1 to Inokawa's base device 17 as a benefit of incorporating two emitters in sensor 1. *See* Ex. 1008, Figs. 3, 19, ¶¶ 3–7, 14, 76–77, 109–111. Inokawa identifies two specific benefits of this optically-based data communication means. First, the infrared LED can transmit the pulse data, and the green LED can separately transmit "checksum" information to increase the accuracy of data transmission. *Id.* at Fig. 19, ¶¶ 14, 109–111. Second, using light emitters in this fashion to perform two functions (data collection by emitting light into the user's wrist, and data transmission by emitting light to photodetectors in a base device) obviates the need for providing "a special wireless communication circuit [in the wrist-worn sensor 1] or a communication cable." *Id.* ¶¶ 3–7, 76–77.

Patent Owner correctly points out that Aizawa already has a "transmitter" 4 for uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for processing and for display to the user. Ex. 1006, Fig. 1(b), ¶¶ 15, 23, 28, 35. However, Aizawa's Figure 1(b) illustrates transmitter 4 only as an empty box contained within outer casing 5, and Aizawa's written description does not provide further structural details concerning transmitter 4. *See id.* In particular, Aizawa does not describe exactly how transmitter 4 transmits its data to the other device. *See id.*

Patent Owner contends, and Dr. Madisetti and Dr. Kenny both testify, that Aizawa's transmitter 4 is a "wireless" transmitter. *See, e.g.*, PO Resp. 53; Ex. 2004 ¶¶ 49, 105–106, 112; Ex. 2007, 403:17–22, 414:19–21. They all appear to equate "wireless" communication to radio frequency communication, and not to include optical communication, even though both radio frequency and optical communication do not use a wire. Based on the foregoing testimony, we assume, for this decision, that Aizawa contemplates radio frequency communication as one embodiment by which transmitter 4 may transmit data to devices other than detector 1.

Patent Owner argues, and Dr. Madisetti testifies, that Aizawa's express disclosure goes even further. They assert Aizawa's "goal" is to measure and display pulse data *in real time during exercise*, using the wireless transmitter. *See, e.g.*, Ex. 2004 ¶¶ 106–108, 111. We find that Aizawa does not support this assertion. Instead, Aizawa discusses prior art devices that "estimat[e] a burden on the heart of a person who takes exercise by *real-time measuring* his/her heart rate at the time of exercise" (Ex. 1006 ¶ 4 (emphasis added)), and then describes Aizawa's detector 1 as having a transmitter for transmitting the measured pulse rate data to another device for display (*id.* ¶ 15). Aizawa does not indicate when this transmission occurs. Aizawa also refers to "noise caused by the shaking of the body of the subject" as a problem to be addressed (*id.* ¶ 6), but this problem occurs regardless of whether the shaking results from exercise or the normal movement of the user's wrist over the course of the day. Thus, Aizawa does not tout, as an important feature of Aizawa's invention, the *real time display* of pulse rate data during exercise, regardless of whether the data gathered by

Aizawa's wrist-worn detector 1 is transmitted wirelessly or otherwise. *Id.* ¶¶ 4, 6, 15.

No doubt, a person of ordinary skill in the art would have viewed the capability of a wrist-worn pulse detector to transmit its pulse data to another device for display in real time while the user is exercising to be a desirable feature in some cases, even if this is not one of Aizawa's specifically stated goals. *See, e.g.*, Ex. 1003 ¶ 72 (Dr. Kenny stating: "By wirelessly transmitting the collected data, the condition of a subject can be determined 'remotely' . . . ."); Ex. 2009, 393:6–14 (in a deposition for other related proceedings, Dr. Kenny agreeing that a person of ordinary skill in the art "would have seen the ability to wirelessly transmit collected data as an advantage"). Nonetheless, Inokawa expressly discloses that, in other cases, the benefits achieved by wireless transmission can be outweighed by obviating the need for the wrist-worn sensor to include a special wireless communication circuit. *See* Ex. 1008 ¶¶ 3–7 (discussing problems associated with wireless transmission, such as the need for a dedicated circuit, which is avoided by Inokawa's system that risks "few malfunctions" and has a "simple structure"), 76–77 ("As a result, there is no need to use a special wireless communication circuit . . ., which makes it possible to transmit vital sign information to the base device 17 accurately, easily, and without malfunction."). We therefore conclude that Petitioner's case for obviousness in this regard is supported by a preponderance of the evidence. *See, e.g.*, *In re Urbanski*, 809 F.3d 1237, 1243–44 (Fed. Cir. 2016) (persons of ordinary skill in the art may be motivated to pursue desirable properties of one prior art reference, even at the expense of foregoing a benefit taught by another prior art reference).

We disagree with Patent Owner's argument that Petitioner's case for obviousness is deficient on the basis that neither Aizawa nor Inokawa expressly discloses a wrist-worn sensor device that has *both* a plurality of emitters *and* at least four detectors, as claim 1 recites. Obviousness does not require "'some motivation or suggestion to combine the prior art teachings' [to] be found in the prior art." *KSR*, 550 U.S. at 407, 415–418. Nor does it require the bodily incorporation of Inokawa's device into Aizawa's device. *See, e.g.*, *In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (test for obviousness is not whether the features of one reference may be bodily incorporated into the structure of the other reference, but rather is "what the combined teachings of the references would have suggested to those of ordinary skill in the art"); *see also In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) (nonobviousness is not established by attacking references individually when unpatentability is predicated upon a combination of prior art disclosures). Instead, "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton," and "in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle." *KSR*, 550 U.S. at 420–421.

In this case, we are persuaded that a person of ordinary skill in the art would have been motivated to modify Aizawa's wrist-worn detector 1 to replace its single near infrared LED 21 with an infrared LED and a green LED, based on Inokawa, for all the reasons provided above. A person of ordinary skill in the art would additionally have known to keep all four detectors 22 that are already present in Aizawa's detector 1, so that "[e]ven when the attachment position of the sensor is dislocated, a pulse wave can be detected accurately," as disclosed by Aizawa. Ex. 1006 ¶¶ 9, 27. In short,

the combination of Aizawa and Inokawa teaches that having multiple emitters is beneficial, and having multiple detectors is beneficial, for different and not inconsistent reasons.

Finally, we agree with Petitioner's position that any thermal interference and power consumption issues that may arise in Aizawa's wrist-worn pulse detector, by using two emitters instead of one emitter, are well within the capabilities of a person of ordinary skill in the art to solve. We credit Dr. Kenny's testimony in this regard. *See* Ex. 1003 ¶ 86; Ex. 1047 ¶ 72. For example, Dr. Kenny acknowledges that Aizawa already discloses adding additional emitters. Ex. 1003 ¶ 79 (citing Ex. 1006 ¶¶ 32–33). Dr. Kenny further testifies that this modification "amount[s] to nothing more than the use of a known technique [i.e., Inokawa's use of two emitters in a wrist-worn pulse detector] to improve similar devices [i.e., Aizawa's wrist-worn pulse detector] in the same way and combining prior art elements according to known methods to yield predictable results." *Id.* ¶ 86.

Patent Owner cites portions of Dr. Kenny's deposition testimony that, in Patent Owner's view, indicate Dr. Kenny fails to appreciate the significance of optical interference complications posed by adding a second emitter to Aizawa's device, and fails to explain how this would have been overcome. *See* PO Resp. 56–57 (citing Ex. 2007, 394:11–395:17). We have reviewed this deposition testimony, and we conclude Patent Owner overstates its significance. It establishes, at most, that Dr. Kenny did not expressly address this issue in his declaration (Exhibit 1003), but Dr. Kenny's opinion is that this would have been within the capability of a person of ordinary skill in the art to resolve. Based on the evidentiary record presented to us, we agree with Dr. Kenny. For example, Inokawa discloses a

wrist-worn pulse sensor 1 having two emitters 21 and 23 in close proximity to each other. *See* Ex. 1008, Figs. 1–2. An artisan must be presumed to know something about the art apart from what the relied-upon references disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962).

Dr. Madisetti's testimony opposing Dr. Kenny's foregoing opinion is premised solely on Dr. Kenny's alleged failure to explain how issues that arise from adding a second emitter to Aizawa would have been solved; Dr. Madisetti does not provide any affirmative reason why these issues would have been difficult for a person of ordinary skill in the art to solve, in the context of Aizawa's device or wrist-worn pulse sensing devices in general. *See* Ex. 2004 ¶ 109.

Thus, we conclude a person of ordinary skill in the art would have been motivated to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, and would have had a reasonable expectation of success in doing so.

iv. "[c] at least four detectors, wherein each of the at least four detectors has a corresponding window that allows light to pass through to the detector"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses at least four detectors, each stored in a separate cavity 23c, which would have been understood to be "openings or windows that mirror specific detector placement layouts." Pet. 48, 43–49; *see, e.g.*, Ex. 1006 ¶¶ 23 ("four phototransistors 22"), 24 ("stored in cavities" and "set back from . . . detection face 23a"), Figs. 1(a)–1(b); Ex. 1003 ¶¶ 111–119.

v. "[d] a wall that surrounds at least the at least the four detectors"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses holder 23, which is a wall that surrounds detectors 22, as well as other elements. Pet. 50–51; *see, e.g.*, Ex. 1006 ¶ 23 ("holder 23 for storing . . . light emitting diode 21 and the photodetectors 22"), Fig. 1(b).

vi. "[e] cover comprising a protruding convex surface, wherein the protruding convex surface is above all of the at least four detectors, wherein at least a portion of the protruding convex surface is rigid, and wherein the cover operably connects to the wall;"

<u>Petitioner's Undisputed Contentions</u>

Petitioner contends that Aizawa discloses a cover, i.e., "an acrylic transparent plate positioned between the photodetectors and the wrist," to improve adhesion between the sensor and the subject's wrist. Pet. 13. Patent Owner does not dispute this contention, and we agree with Petitioner. Aizawa discloses that "acrylic transparent plate 6 is provided on the detection face 23a of the holder 23 to improve adhesion to the wrist 10." Ex. 1006 ¶ 34, Fig. 1(b) (depicting transparent plate 6 between sensor 2 and wrist 10).

Petitioner also contends that Ohsaki teaches a wrist-worn sensor that includes a "translucent board" having a convex surface that contacts the user's skin. Pet. 16, 31. Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki discloses that sensor 1 includes detecting element 2 and sensor body 3, and is "worn on the back side of the user's wrist." Ex. 1009 ¶ 16. Ohsaki discloses that detecting element 2 includes package 5 and "translucent board 8[,which] is a glass board which is transparent to light, [and is] attached to the opening of the package 5. A

convex surface is formed on the top of the translucent board 8." *Id.* ¶ 17. As seen in Ohsaki's Figure 2, translucent board 8 has a protruding convex surface, and is located above all of the detectors. *Id.* at Fig. 2. As also seen in Figure 2, the cover is operably connected to the walls of sensor package 5. *Id.* ¶ 17 ("The translucent board 8 is . . . attached to the opening of the package 5."), Fig. 2.

Petitioner also contends that Ohsaki's Figure 2 depicts the user's tissue conforming to the shape of the convex surface of the cover, such that the convex surface would have been "rigid." Pet. 53. Patent Owner does not dispute this contention, and we agree with Petitioner. Ohsaki's Figure 2 depicts the user's tissue 4 conforming to the shape of the protruding convex surface when the sensor is worn by the user. Ex. 1009 ¶ 17 ("The translucent board 8 is a glass board."), Fig. 2; *see, e.g.*, Ex. 1003 ¶ 124.

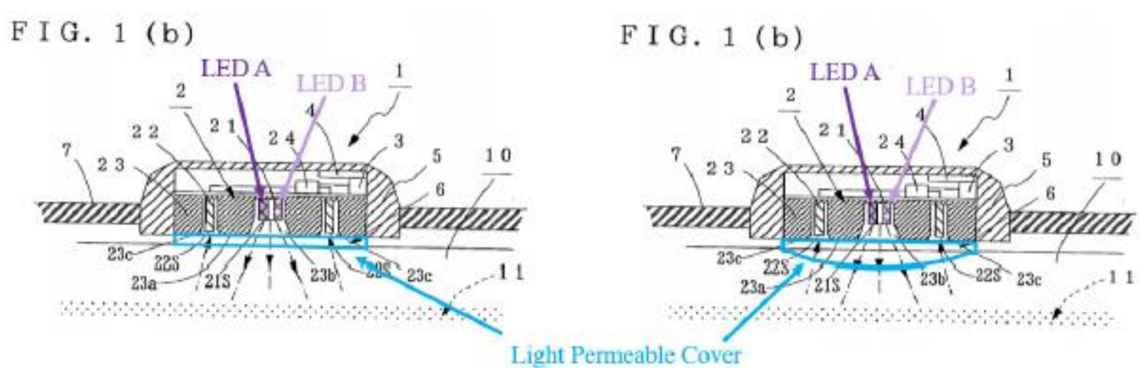
<u>Petitioner's Disputed Contentions</u>

Petitioner further contends that a person of ordinary skill in the art would have found it obvious "to modify the sensor's flat cover [in Aizawa] . . . to include a lens/protrusion . . . similar to Ohsaki's translucent board 8, so as to [1] improve adhesion between the user's wrist and the sensor's surface, [2] improve detection efficiency, and [3] protect the elements within sensor housing." Pet. 33, 52 (citing, e.g., Ex. 1003 ¶¶ 25, 100–101; Ex. 1006 ¶¶ 2, 5, 8–16, 23–24, 27–29, 32–33). Petitioner contends that Ohsaki's convex surface is in "intimate contact" with the user's tissue, which prevents slippage of the sensor and increases signal strength because "variation of the amount of the reflected light . . . that reaches the light receiving element 7 is suppressed" and because "disturbance light from the outside" is prevented from penetrating board 8, as compared to a sensor with

a flat surface. *Id.* at 31–32 (citing, e.g., Ex. 1003 ¶ 99; quoting Ex. 1009 ¶ 25). Petitioner also contends that, in the combination, the protruding convex surface would have been rigid, and the cover would have operably connected to the wall, as taught by Ohsaki. Pet. 52–53.

Petitioner contends this modification would have been "nothing more than the use of a known technique to improve similar devices in the same way," i.e., "simply improving Aizawa-Inokawa's transparent plate 6 that has a flat surface to improve adhesion to a subject's skin and reduce variation in the signals detected by the sensor." Pet. 34 (citing Ex. 1003 ¶ 102). Further according to Petitioner, "the elements of the combined system would each perform functions they had been known to perform prior to the combination—Aizawa-Inokawa's transparent plate 6 would remain in the same position, performing the same function, but with a convex surface as taught by Ohsaki." *Id.* at 34–35.

To illustrate its proposed modification, Petitioner includes two annotated versions of Aizawa's Figure 1(b), both of which are reproduced below. Pet. 34.



Petitioner's annotated figure on the left depicts Aizawa's sensor, modified to include LED B (*see supra* Section II.D.5.iii) and with a flat "light permeable cover" (illustrated with blue outline); Petitioner's annotated figure on the

right depicts Aizawa's sensor, again modified to include LED B (*see supra* Section II.D.5.iii) and with a convex "light permeable cover" (also illustrated with blue outline).

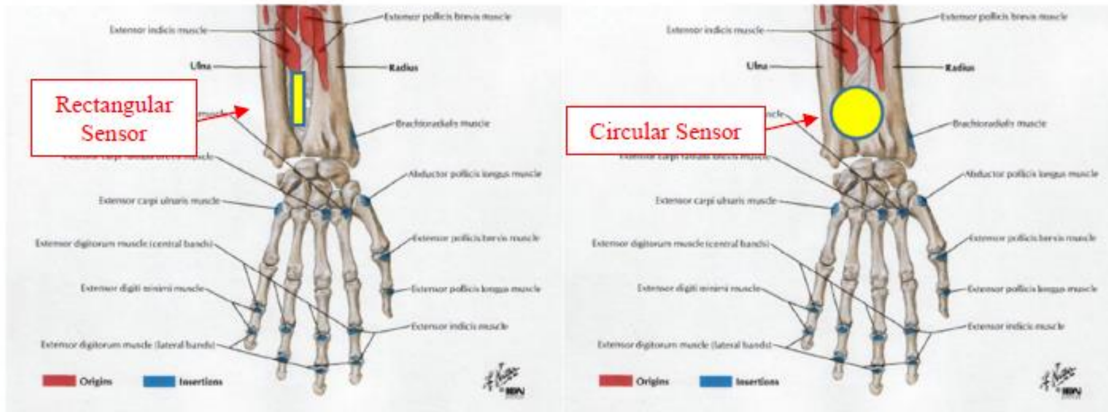
Patent Owner's Arguments

Patent Owner argues that a person of ordinary skill in the art would not have been motivated to modify Aizawa's sensor to include Ohsaki's convex cover. PO Resp. 19–50; PO Sur-reply 3–23.

First, Patent Owner argues that the proposed modification "fundamentally changes Ohsaki's structure and eliminates the longitudinal shape that gives Ohsaki's translucent board the ability to prevent slipping." PO Resp. 20. This argument is premised on Patent Owner's contention that Ohsaki's convex cover must be rectangular, with the cover's long direction aligned with the length of the user's forearm, to avoid interacting with bones in the wrist and forearm. *Id.* at 22–24 (citing, e.g., Ex. 2004 ¶¶ 52–57; Ex. 1009 ¶¶ 6, 19, 23, 24); PO Sur-reply 3–11. According to Patent Owner, Ohsaki teaches that "aligning the sensor's longitudinal direction with the circumferential direction of the user's arm undesirably results in 'a tendency [for Ohsaki's sensor] to slip off.'" PO Resp. 22–23 (citing Ex. 1009 ¶ 19).

Thus, Patent Owner contends that Petitioner's proposed modification would "chang[e] Ohsaki's rectangular board into a circular shape," which "would eliminate the advantages discussed above" because it "cannot be placed in ***any longitudinal*** direction and thus cannot coincide with the longitudinal direction of the user's wrist." *Id.* at 23 (citing Ex. 2004 ¶¶ 56–57). Patent Owner presents annotated Figures depicting what it contends is Ohsaki's disclosed sensor placement as compared to that of the proposed modification, reproduced below. *Id.* at 24.

Ohsaki's Longitudinal Teachings Petitioner's Proposed Combination



Patent Owner's annotated Figure on the left depicts a rectangular sensor placed between a user's radius and ulna, while Patent Owner's annotated Figure on the right depicts a circular sensor placed across a user's radius and ulna. Based on these annotations, Patent Owner argues that the proposed "circular shape would press on the user's arm in all directions and thus cannot avoid the undesirable interaction with the user's bone structure," such that a skilled artisan "would have understood such a change would eliminate Ohsaki's benefit of preventing slipping." *Id.* (citing, e.g., Ex. 2004 ¶¶ 56–57).

Second, Patent Owner argues that Ohsaki requires its sensor be placed on the back of the user's wrist to achieve any benefits, but that such a location would have been unsuitable for Aizawa's sensor. PO Resp. 29–30. Specifically, Patent Owner argues that Aizawa's sensor must be worn on the palm side of the wrist, close to radial and ulnar arteries, which is the side opposite from where Ohsaki's sensor is worn. *Id.* at 29–34 (citing, e.g., Ex. 2004 ¶¶ 66–73). According to Patent Owner, Ohsaki teaches that the sensor's convex surface has a tendency to slip when placed on the palm side of the wrist, i.e., in the location taught by Aizawa. *Id.* at 35–38 (citing, e.g.,

Ex. 1009 ¶¶ 19, 23, 24; Ex. 2004 ¶¶ 74–80). Thus, Patent Owner argues that a person of ordinary skill in the art "would not have been motivated to use Ohsaki's longitudinal board—designed to be worn on the ***back side*** of a user's wrist—with Aizawa's ***palm-side*** sensor." *Id.* at 38. Similarly, Patent Owner argues that Aizawa teaches away from the proposed modification because Aizawa teaches that its flat acrylic plate improves adhesion on the palm side of the wrist, while Ohsaki teaches that its convex board "has a tendency to slip" on the palm side of the wrist. *Id.* at 39–41 (citing, e.g., Ex. 2004 ¶¶ 82–84).

Third, Patent Owner argues that a person of ordinary skill in the art would not have placed Ohsaki's convex cover over Aizawa's peripheral detectors because the convex cover would condense light toward the center and away from Aizawa's detectors, which would decrease signal strength. PO Resp. 41–48 (citing, e.g., Ex. 2004 ¶¶ 85–97). Patent Owner also contends that Petitioner and Dr. Kenny admitted as much in a related proceeding. *Id.* at 42–43 (citing, e.g., Ex. 2019, 45; Ex. 2020, 69–70). Patent Owner also relies on Figure 14B of the '765 patent to support its position. *Id.* at 43 (citing Ex. 1001, 36:3–6, 36:13–15). Additionally, Patent Owner argues that its position is also supported by Inokawa, which also uses a convex lens to direct light toward the center but, in Inokawa's structure, the light is directed from peripheral emitters toward a central detector. *Id.* at 47–48 (citing, e.g., Ex. 1008 ¶¶ 15, 58). In light of the foregoing, Patent Owner argues that a person of ordinary skill in the art would have understood that the proposed modification would have decreased signal strength by directing light away from Aizawa's peripheral detectors. *Id.* at 45–48.

Fourth and finally, Patent Owner argues that a person of ordinary skill in the art "would have understood that Aizawa's ***flat*** plate would provide better protection than a convex surface" because it "would be less prone to scratches." *Id.* at 49–50 (citing Ex. 1008 ¶ 106).

Petitioner's Reply

Concerning Patent Owner's first and second arguments, Petitioner responds that Ohsaki does not disclose the shape of its protrusion, other than its convexity as shown in Figures 1 and 2, nor does Ohsaki require a rectangular shape or placement on the back of the wrist in order to achieve the disclosed benefits. Pet. Reply 13–21 (citing, e.g., Ex. 1047 ¶¶ 16–33). Moreover, Petitioner asserts that "even if Ohsaki's translucent board 8 were somehow understood to be rectangular, obviousness does not require 'bodily incorporation' of features from one reference into another"; rather, a person of ordinary skill in the art "would have been fully capable of modifying Aizawa to feature a light permeable protruding convex cover to obtain the benefits" taught by Ohsaki. *Id.* at 17 (citing, e.g., Ex. 1047 ¶ 26). Similarly, regarding the location of the sensor, Petitioner asserts,

> [E]ven assuming for the sake of argument that a [person of ordinary skill in the art] would have understood Aizawa's sensor as being limited to placement on the backside of the wrist, and would have understood Ohsaki's sensor's "tendency to slip" when arranged on the front side as informing consideration of Ohsaki's teachings with respect to Aizawa, that ***would have further motivated*** the [person of ordinary skill in the art] to implement a light permeable convex cover in Aizawa's sensor, to improve detection efficiency of that sensor when placed on the palm side.

Id. at 19 (citing, e.g., Ex. 1047 ¶ 30). In other words, Ohsaki's disclosure that a convex surface suppresses variation in reflected light would have

motivated an artisan to add such a surface to Aizawa to improve detection efficiency of that sensor when placed on the palm side. *Id.* at 20–21.

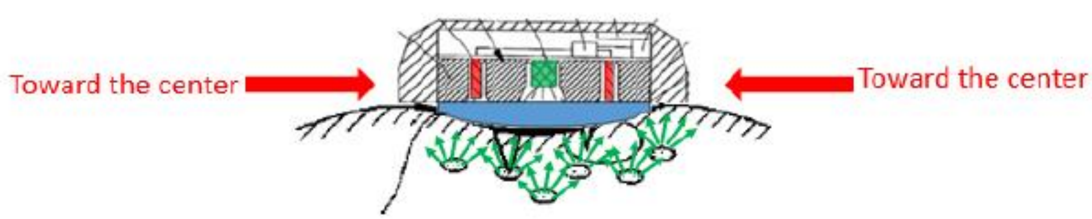
Concerning Patent Owner's third argument, Petitioner responds that adding a convex cover to Aizawa's sensor would not decrease signal strength but, instead, "would improve Aizawa's signal-to-noise ratio by causing more light backscattered from tissue to strike Aizawa's photodetectors than would have with a flat cover" because such a cover improves light concentration across the entire lens and does not direct it only towards the center. *Id.* at 21–28 (citing, e.g., Ex. 1047 ¶¶ 34–58).

Petitioner asserts that Patent Owner and Dr. Madisetti "ignore[] the well-known ***principle of reversibility***," by which "a ray going from P to S will trace the same route as one from S to P." Pet. Reply 23 (quoting Ex. 1051, 92; citing, e.g., Ex. 1051, 87–92; Ex. 1049, 106–111; Ex. 1047 ¶ 38). When applied to Aizawa's sensor, Petitioner contends that any condensing benefit achieved by a convex cover would thus direct emitted light toward Aizawa's peripheral detectors. *Id.* at 24–26 (citing, e.g., Ex. 1047 ¶¶ 40–49). Although Dr. Madisetti "refused to acknowledge" "this basic principle of reversibility during deposition," Petitioner contends it is applied in Aizawa. *Id.* at 25 (citing, e.g., Ex. 1052, 89:12–19; Ex. 1003 ¶ 127 (citing Ex. 1006 ¶ 33); Ex. 1047 ¶ 34).

Petitioner also asserts that Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue will be scattered and diffuse and will approach the detectors "from various random directions and angles." Pet. Reply 26–28 (citing, e.g., Ex. 1019, 52, 86, 90; Ex. 1053, 803; Ex. 1047 ¶¶ 50–56; Ex. 2006, 163:12–164:2). This scattered and diffuse light, according to Petitioner, means that Ohsaki's convex cover cannot

"focus all light at the center of the sensor device," as Patent Owner argues. *Id.* at 27. Instead, due to the random nature of this scattered light, Petitioner asserts that a person of ordinary skill in the art would have understood that "Ohsaki's convex cover provides a slight refracting effect, such that light rays that otherwise would have missed the detection area are instead directed toward that area as they pass through the interface provided by the cover." *Id.* at 28 (citing, e.g., Ex. 1047 ¶¶ 55–56). Petitioner applies this understanding to Aizawa, and asserts that using a cover with a convex protrusion in Aizawa would "enable backscattered light to be detected within a circular active detection area surrounding" a central light source. *Id.* at 28 (citing, e.g., Ex. 1047 ¶ 56).

Petitioner relies upon the following illustration of this alleged effect. Pet. Reply 30–31 (citing Ex. 1047 ¶¶ 62–67).



The above illustration depicts backscattered light reflecting off user tissue in various directions, such that it impinges upon the peripheral detectors from various random angles and directions. *Id.* According to Petitioner, "light rays that otherwise would have missed the active detection area are instead directed toward that area as they pass through the interface provided by the convex cover." *Id.* at 31.

Finally, Petitioner dismisses Patent Owner's reliance on Figure 14B of the '765 patent because it "is not an accurate representation of light that has been reflected from a tissue measurement site. For example, the light

rays (1420) shown in FIG. 14B are collimated (i.e., travelling paths parallel to one another), and each light ray's path is perpendicular to the detecting surface." Pet. Reply 28–29 (citing, e.g., Ex. 1047 ¶¶ 57–60).

Concerning Patent Owner's fourth argument, Petitioner responds that even if a flat surface might be less prone to scratching, that possible disadvantage would have been weighed against the "known advantages of applying Ohsaki's teachings," and would not negate a motivation to combine. *Id.* at 33 (citing, e.g., Ex. 1047 ¶ 68). Moreover, Petitioner argues that "by choosing a suitable material of the protrusion to be scratch-resistant, it would have been obvious for a [person of ordinary skill in the art] to achieve both benefits of light gathering and scratch-resistance." *Id.*

Patent Owner's Sur-reply

Concerning Patent Owner's first and second arguments, Patent Owner reiterates its position that Ohsaki's purported benefits attach only to a sensor with a rectangular convex surface that is located on the back of the wrist, and that "even small changes in its sensor's orientation or body location result in 'a tendency to slip.'" PO Sur-reply 3–14, 6.

Concerning Patent Owner's third argument, Patent Owner asserts that Petitioner's Reply improperly presents several new theories as compared with the Petition. *Id.* at 16 (regarding reversibility), 19 (regarding refraction).

Patent Owner argues that Dr. Kenny and Petitioner have not overcome their admissions that a convex lens directs light toward the center. *Id.* at 15. Moreover, Patent Owner argues that Petitioner's discussion of the principle of reversibility is "irrelevant" because "Petitioner never explains how the principle of reversibility could apply to such 'random' scattered and

absorbed light" as is present when light interacts with user tissue. *Id.* at 16–17. The random nature of backscattered light, in Patent Owner's view, "hardly supports Petitioner's argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed," and is irrelevant to the central issue presented here of "whether changing Aizawa's flat surface to a convex surface results in more light on Aizawa's peripherally located detectors." *Id.* at 17–18.

Patent Owner also asserts that Petitioner mischaracterizes Patent Owner's position, which is not that a cover with a convex protrusion "focuses ***all*** light to a single point" at the center of the sensor as Petitioner characterizes it. PO Sur-reply 19. Patent Owner's position, rather, is that Petitioner has not shown that a person of ordinary skill in the art "would have been motivated to change Aizawa's flat surface to a convex surface to improve signal strength." *Id.* In Patent Owner's view, by arguing that the convex cover provides only a "slight refracting effect," Petitioner undermines its contention that providing such a cover would have improved detection efficiency. *Id.* at 19–20.

Moreover, Patent Owner argues that Petitioner's theory regarding the "slight refracting effect" of a convex protrusion is "unavailing because it fails to consider the greater ***decrease*** in light at the detectors due to light redirection to a ***more*** central location." *Id.* at 20. According to Patent Owner, any light redirected from the sensor's edge could not make up for the loss of signal strength from light redirected away from the detectors and toward the center. *Id.*

Concerning Patent Owner's fourth argument, Patent Owner argues that Petitioner does not dispute Patent Owner's position that a flat cover

would be less prone to scratches and offers "***no*** plausible advantages for its asserted combination." *Id.* at 23. Moreover, Patent Owner argues that "the risk of scratches undermines Petitioner's argument that a [person of ordinary skill in the art] would have been motivated to add a convex cover to 'protect the elements within the sensor housing.'" *Id.*

Analysis

As noted above, Petitioner provides three rationales to support its contention that a person of ordinary skill in the art would have provided "a light permeable cover with a protruding convex surface," such as that taught by Ohsaki, to Aizawa's sensor: (1) to improve adhesion between the sensor and the user's tissue, (2) to improve detection efficiency, and (3) to protect the elements within the sensor housing. Pet. 33. We conclude all three rationales are supported by the evidence, as follows.

Rationales 1 and 2

The evidence of record persuades us that adding a convex cover, such as that taught by Ohsaki, would have improved adhesion between the sensor and the user's skin, which would have increased the signal strength of the sensor. Ohsaki teaches as much:

> [T]he convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby *it is prevented that the detecting element 2 slips off* the detecting position of the user's wrist 4. If the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4 as shown in Fig. 4B. However, in the case that the translucent board 8 has a convex surface like the present embodiment, the *variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed*. *It is also prevented*

> *that noise such as disturbance light from the outside penetrates the translucent board 8*. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25 (emphases added); *see also id.* ¶ 27 ("stably fixed").

We credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated by such teachings to apply a cover with a convex surface to Aizawa to improve that similar device in the same way and to yield predictable results, i.e., to resist movement of the sensor on the user's wrist. *See, e.g.*, Ex. 1003 ¶¶ 99 ("[T]his contact between the convex surface and the user's skin is said to prevent slippage, which increases the strength of the signals obtainable by Ohsaki's sensor."), 101–102. We also credit Dr. Kenny's testimony that, in light of these teachings, a person of ordinary skill in the art would have made such a modification to improve the pulse sensor's ability to emit light into, and detect light reflected from, the user's wrist, to generate an improved pulse signal. Ex. 1003 ¶¶ 71, 98, 100; Ex. 1047 ¶¶ 7, 14.

Indeed, Ohsaki expressly compares the performance of a wrist-worn pulse wave sensor depending on whether translucent board 8 is convex or flat, and concludes the convex surface results in improved performance over the flat surface, especially when the user is moving. Ex. 1009, Figs. 4A–4B, ¶¶ 15, 25 (stating that with "a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4," and with "a convex surface like the present embodiment, the variation of the amount of the reflected light" collected by the sensor "is suppressed"). Ohsaki also states that, with a convex surface, "[i]t is also prevented that noise such as

disturbance light from the outside penetrates the translucent board 8." *Id.* ¶ 25.

We also credit Dr. Kenny's testimony that the proposed modification would have been within the skill level of an ordinary artisan. For example, Dr. Kenny testifies:

> [A person of ordinary skill in the art] would have combined the teachings of Aizawa-Inokawa and Ohsaki as doing so would have amounted to nothing more than the use of a known technique to improve similar devices in the same way. [One of ordinary skill] would have recognized that incorporating Ohsaki's convex surface is simply improving Aizawa-Inokawa's transparent plate 6 that has a flat surface to improve adhesion to a subject's skin and reduce variation in the signals detected by the sensor. Furthermore, the elements of the combined system would each perform similar functions they had been known to perform prior to the combination—Aizawa-Inokawa's transparent plate 6 would remain in the same position, performing the same function, but with a convex surface as taught by Ohsaki.

Ex. 1003 ¶ 102. In light of Ohsaki's express disclosure of the benefits of a convex cover, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have been motivated to modify Aizawa as proposed, and would have had a reasonable expectation of success in doing so.

We next address Patent Owner's first through third arguments, each of which implicates Petitioner's first and second asserted rationales of improved adhesion and detection efficiency.

Patent Owner's first argument is premised on the notion that Ohsaki's benefits only can be realized with a rectangular convex surface, because such a shape is required to avoid interacting with bones on the back of the user's forearm. PO Resp. 20–28. We disagree. Ohsaki does not disclose

the shape of its convex cover, much less require it be rectangular. In fact, Ohsaki is silent as to the shape of the convex surface. Ohsaki discloses that sensor 1 includes detecting element 2, which includes package 5 within which the sensor components are located. Ex. 1009 ¶ 17. Ohsaki's convex surface is located on board 8, which is "attached to the opening of the package 5." *Id.* Ohsaki provides no further discussion regarding the shape of board 8 or its convex protrusion.

We disagree with Patent Owner's suggestion that the shape of the convex surface can be inferred to be rectangular from Ohsaki's Figures 1 and 2. PO Resp. 15–17. Ohsaki does not indicate that these figures are drawn to scale, or reflect precise dimensions or shapes of the convex surface. *See, e.g.*, Ex. 1009 ¶ 13 ("schematic diagram"); Pet. Reply 16–17; *Hockerson-Halberstadt, Inc. v. Avia Group Int'l*, 222 F.3d 951, 956 (Fed. Cir. 2000) ("[I]t is well established that patent drawings do not define the precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue.").

To be clear, Ohsaki describes the shape of *detecting element 2* as rectangular: "[T]he length of the detecting element from the right side to the left side in FIG. 2 is longer than the length from the upper side to the lower side." Ex. 1009 ¶ 19. Ohsaki also describes that detecting element 2 is aligned longitudinally with the user's forearm: "[I]t is desirable that the detecting element 2 is arranged so that its longitudinal direction agrees with the longitudinal direction of the user's arm," to avoid slipping off. *Id.*; *see also id.* ¶ 9 ("The light emitting element and the light receiving element are arranged in the longitudinal direction of the user's arm.").

In light of this disclosed rectangular shape of detecting element 2, it is certainly possible that Ohsaki's convex surface may be similarly shaped. But, it may not be. Contrary to Patent Owner's argument, Ohsaki neither describes nor requires detecting element 2 to have the same shape as the convex surface of board 8. *Accord* Pet. Reply. 14 (noting also that Ohsaki's board 8 "is not coextensive with the entire tissue-facing side of detecting element 2"). We have considered the testimony of both Dr. Kenny and Dr. Madisetti on this point. Ex. 1047 ¶¶ 10, 13, 19–26; Ex. 2004 ¶¶ 37–41 (relying on Ohsaki's Figures 1–2 to support the opinion that the convex surface is rectangular). Dr. Madisetti's reliance on the dimensions of Ohsaki's figures is unpersuasive. *Hockerson-Halberstadt*, 222 F.3d at 956. We credit Dr. Kenny's testimony that Ohsaki does not describe its convex surface as rectangular, because this testimony is most consistent with Ohsaki's disclosure.

Further, Patent Owner suggests that the convex surface *must be* rectangular, in order to avoid interacting with bones in the user's forearm. PO Resp. 21–23; PO Sur-reply 10 ("[A person of ordinary skill in the art] would have understood Ohsaki's convex board must ***also*** have a longitudinal shape oriented up-and-down the watch-side of the user's wrist/forearm."). Although Ohsaki recognizes that interaction with these bones can cause problems, (*see* Ex. 1009 ¶¶ 6, 19), we do not agree that the *only way* to avoid these bones is by aligning a rectangular cover with the longitudinal direction of the user's forearm. For example, in the annotated Figures provided by Patent Owner, *see* PO Resp. 24, we discern that the circular sensor that purports to depict the proposed modification would *also* avoid the bones in the forearm if it were slightly smaller. Patent Owner provides no persuasive

explanation to justify the dimensions it provides in this annotated figure, or to demonstrate that such a large sensor would have been required. Indeed, we discern that it would have been within the level of skill of an ordinary artisan to appropriately size a modified sensor to avoid these well-known anatomical obstacles. "A person of ordinary skill is also a person of ordinary creativity, not an automaton." *KSR*, 550 U.S. at 421. After all, an artisan must be presumed to know something about the art apart from what the references disclose. *See In re Jacoby*, 309 F.2d at 516.

Finally, we do not agree with Patent Owner's position that Ohsaki's advantages apply only to rectangular convex surfaces. As discussed, Patent Owner has not shown that Ohsaki's convex surface is rectangular at all. Moreover, even if Ohsaki's convex surface is rectangular, when discussing the benefits associated with a convex cover, Ohsaki does not limit those benefits to a cover of any particular shape. Instead, Ohsaki explains that "detecting element 2 is arranged on the user's wrist 4 so that the convex surface of the translucent board 8 is in intimate contact with the surface of the user's skin. Thereby it is prevented that the detecting element 2 slips off the detecting position of the user's wrist 4." Ex. 1009 ¶ 25; Ex. 1047 ¶¶ 12–13. Thus, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa's circular-shaped sensor, to improve adhesion as taught by Ohsaki. Nothing in Ohsaki's disclosure limits such a benefit to a specific shape of the convex surface. Ex. 1047 ¶¶ 10, 12–14, 19–26.

Moreover, Ohsaki contrasts the ability to properly receive reflected light with a convex surface as compared to a flat surface and notes that,

> in the case that the translucent board 8 has a convex surface . . . the variation of the amount of the reflected light which is emitted from the light emitting element 6 and reaches the light receiving element 7 by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board 8. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist 4 as shown in FIG. 4A.

Ex. 1009 ¶ 25; Ex. 1047 ¶ 13. Again, we agree with Petitioner that Ohsaki's teaching of a convex surface would have motivated a person of ordinary skill in the art to add such a surface to Aizawa's sensor, to improve signal strength, as taught by Ohsaki. Again, nothing in Ohsaki's disclosure limits such a benefit to the shape of the convex surface. Ex. 1047 ¶¶ 13, 19–26. Accordingly, we do not agree that Ohsaki's disclosed advantages attach only to a rectangular convex surface, or would have been inapplicable to the proposed combination of Aizawa and Ohsaki.[5]

We have considered Patent Owner's second argument, that Ohsaki's benefits are realized only when the sensor and convex surface are placed on the back of the user's wrist, which is the opposite side of the wrist taught by Aizawa. PO Resp. 28–41. We do not agree. As an initial matter, Petitioner does not propose bodily incorporating the references; Petitioner simply proposes adding a convex cover to Aizawa's sensor, without discussing where Aizawa's sensor is used. *See, e.g.*, Pet. 31. In other words,

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[5] Patent Owner also argues that, to the extent contended by Petitioner, it would not have been obvious to place a rectangular cover on top of Aizawa's sensor. PO Resp. 26–28. We do not understand Petitioner to have made any such contention and, accordingly, do not address this argument. *See, e.g.*, Pet. 31–35.

Petitioner's proposed modification does not dictate any particular placement, whether on the palm side or back side of the wrist.

To be sure, Ohsaki's Figures 3A–3B compare the performance of detecting element 2, including its translucent board 8 having a convex protrusion, and show better performance when the element is attached to the back side of the wrist versus the front side of the wrist, when the user is in motion. *See* Ex. 1009 ¶¶ 23–24, Figs. 3A–3B. However, we do not agree that these figures support Dr. Madisetti's conclusion that "Ohsaki indicates a convex surface only prevents slipping on the back (i.e., watch) side of the wrist in a specific orientation, but tends to slip when used in different locations or orientations" such as the palm side of the wrist—particularly in comparison to a flat surface such as Aizawa's. Ex. 2004 ¶¶ 66, 75. Instead, Ohsaki acknowledges that, even when the detecting element is located "on the front [palm] side of the user's wrist 4, *the pulse wave can be detected well* if the user is at rest." Ex. 1009 ¶ 23 (emphasis added). Thus, Ohsaki discloses that, in at least some circumstances, a convex surface located on the front of the user's wrist achieves benefits. *Id.* Notably, the claims are not limited to detection during movement or exercise.

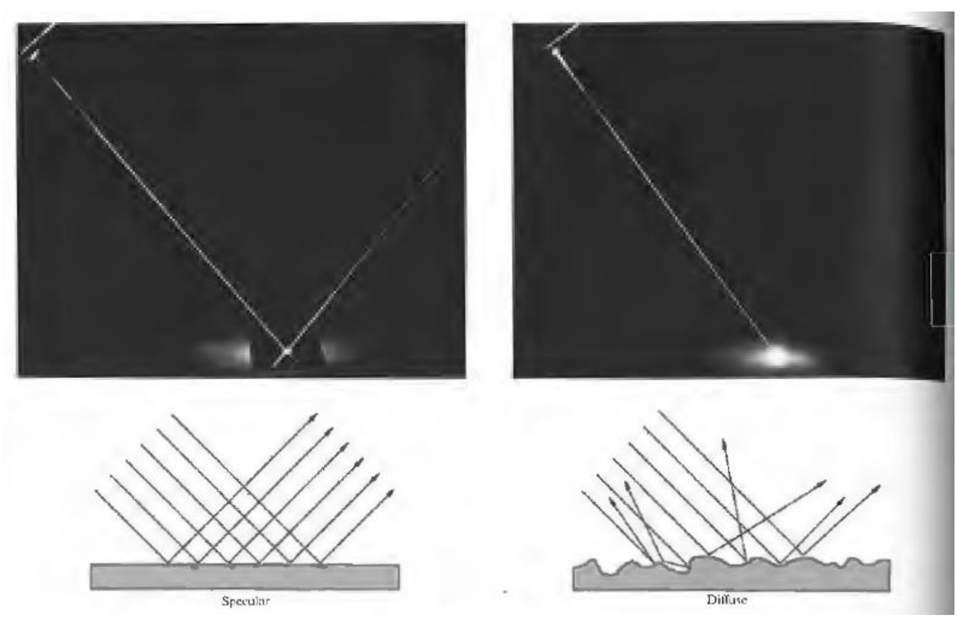
We credit, instead, Dr. Kenny's testimony that a person of ordinary skill in the art would have understood from Ohsaki that a convex protrusion will help prevent slippage, even in the context of Aizawa's sensor. *See* Ex. 1047 ¶¶ 11, 14, 16, 27–33. This is because the convex protrusion is in "intimate contact with the surface of the user's skin," *id.* ¶ 12, which "would have provided improved adhesion as described by Ohsaki in a sensor placed, e.g., on the palm side of the wrist, or other locations on the body." *Id.* ¶¶ 16, 28.

Dr. Madisetti testifies that "[b]ased on Aizawa's teaching that a flat acrylic plate improves adhesion on the palm side of the wrist, and Ohsaki's teaching that a convex surface tends to slip on the palm side of the wrist, a [person of ordinary skill in the art] would have come to the opposite conclusion from Dr. Kenny: that modifying Aizawa's flat adhesive plate 'to include a lens/protrusion . . . similar to Ohsaki's translucent board' would not 'improve adhesion.'" Ex. 2004 ¶¶ 84, 82. We disagree with this reading of Aizawa. It is true that Aizawa's plate 6 is illustrated as having a flat surface (Ex. 1006, Fig. 1(b)), and that Aizawa states the plate "improve[s] adhesion" (*id.* ¶ 13). Aizawa further states: "the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10," and "[t]hereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶ 26. These disclosures, however, indicate the improved adhesion is provided by the acrylic material of plate 6, not the shape of the surface of the plate, which is never specifically addressed. *Id.* ¶¶ 30, 34 ("Since the acrylic transparent plate 6 is provided . . . adhesion between the pulse rate detector 1 and the wrist 10 can be improved . . . ."). Aizawa does not associate this benefit of improved adhesion with the surface shape of the plate, but rather, with the existence of an acrylic plate to begin with. Thus, there is no teaching away from using a convex surface to improve the adhesion of Aizawa's detector to the user's wrist.

We have considered Patent Owner's third argument that a convex cover would condense light away from Aizawa's peripheral detectors, which Patent Owner alleges would decrease signal strength. PO Resp. 41–48. We disagree.

There appears to be no dispute that when emitted light passes through user tissue, the light diffuses and scatters as it travels. *See, e.g.*, Pet. Reply 26 ("[R]eflectance-type sensors detect light that has been 'partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector.' Thus, a [person of ordinary skill in the art] would have understood that light reaches the active detection area from various random directions and angles.") (quoting Ex. 1019, 86); PO Sur-reply 16 ("Even Petitioner admits, however, that tissue randomly scatters and absorbs light rays."), Tr. 33:13–34:7 (Patent Owner's counsel stating that "when [light] goes into the tissue you get the diffusion and that is random scattering, correct").

The light thus travels at random angles and directions, and no longer travels in a collimated and perpendicular manner. Exhibit 1050,[6] Figure 4.12, illustrates the difference between diffuse and collimated light, and is reproduced below:



[6] Eugene Hecht, *Optics* (2nd ed. 1990).

This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a photograph and an illustration of incoming collimated light reflecting from a rough surface. *See* Ex. 1050, 87–88 (original page numbers). The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. *See id.* The rough surface provides diffuse reflection, in which the reflected light rays travel in random directions. *See id.*; *see also* Ex. 1047 ¶¶ 42–43 (discussing Ex. 1050, Figure 4.12), 50 ("A [person of ordinary skill in the art] would have understood that light that backscatters from the measurement site (after diffusing through tissue) reaches the active detection area from many random directions and angles.").

Dr. Kenny testifies that Aizawa's sensor "detect[s] light that has been 'partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector.'" Ex. 1047 ¶ 50 (quoting Ex. 1019, 86). Dr. Kenny further opines that a convex cover, when added to Aizawa's sensor with multiple detectors symmetrically arranged about a central light source, "allows light rays that otherwise would have missed the detection area to instead be directed toward that area as they pass through the interface provided by the cover," thus increasing the light-gathering ability of Aizawa's sensor. *Id.* ¶¶ 56, 62.

By contrast Dr. Madisetti testifies that "a convex 'lens/protrusion' would direct light away from the detectors and thus result in decreased light collection and optical signal strength at the peripheral detectors" because it condenses light towards the center of the sensor and away from the peripheral detectors. Ex. 2004 ¶¶ 85–86, 89. We have considered this

testimony, however, Dr. Madisetti's opinions largely are premised upon the behavior of collimated and perpendicular light as depicted in Figure 14B of the challenged patent. *See id.* ¶ 88. Dr. Madisetti does not explain how light would behave when approaching the sensor from various angles, as it would after being reflected by tissue. *Id.* ¶¶ 86–89; *see also id.* ¶¶ 90–97 (addressing motivation and also failing to discuss diffuse, scattered light). In other words, even if Patent Owner is correct that the '765 patent's Figure 14B depicts light condensing toward the center, this is not dispositive to the proposed modification, because light reflected by a user's tissue is scattered and random, and is not collimated and perpendicular as shown in Figure 14B. Ex. 1001, Fig. 14B.

Patent Owner and Dr. Madisetti argue that "Petitioner and Dr. Kenny both [previously admitted] that a convex cover condenses light towards the center of the sensor and away from the periphery," in a different petition filed against a related patent, i.e., in IPR2020-01520. PO Resp. 42–44; Ex. 2004 ¶ 86. The cited portions of the Petition and Dr. Kenny's declaration from IPR2020-01520 discuss a decrease in the "mean path length" of a ray of light when it travels through a convex lens rather than through a flat surface. *See, e.g.*, Ex. 2020 ¶¶ 118–120. We do not agree that this discussion is inconsistent with Dr. Kenny's testimony here that, where light is reflected to the detectors at various random angles and directions, more light will reach Aizawa's symmetrically disposed detectors when travelling through the convex surface than would be reached without such a surface, because light that might have otherwise missed the detectors now will be captured. *See, e.g.*, Ex. 1047 ¶¶ 34, 37, 56; *see generally id.* ¶¶ 34–67. We do not discern that the convergence of a single ray of light toward

the center, as discussed in IPR2020-01520, speaks to the aggregate effect on *all* light that travels through the convex surface.

We additionally do not agree with Patent Owner's argument that Petitioner's Reply presents new theories that should have been first presented in the Petition, to afford Patent Owner an adequate opportunity to respond. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, for the purpose of, *inter alia*, increasing the light gathering ability of Aizawa's device. *See* Pet. 31–35. Patent Owner's Response then challenged that contention, with several arguments that Petitioner's proposed convex protrusion would not operate in the way the Petition alleges it would operate. *See* PO Resp. 41–48. This opened the door for Petitioner to provide, in the Reply, arguments and evidence attempting to rebut the contentions in the Patent Owner Response. *See* PTAB Consolidated Trial Practice Guide (Nov. 2019) ("Consolidated Guide"),[7] 73 ("A party also may submit rebuttal evidence in support of its reply."). This is what Petitioner did here. The Reply does not change Petitioner's theory for obviousness; rather, the Reply presents more argument and evidence in support of the same theory for obviousness presented in the Petition. *Compare* Pet. 31–35, *with* Reply 21–32.

Rationale 3

Petitioner further contends that a person of ordinary skill in the art would have recognized that a cover with a protruding convex surface, such as that taught by Ohsaki, would "protect the elements within the sensor housing" of Aizawa. Pet. 33. We are persuaded that adding a convex cover,

[7] Available at https://www.uspto.gov/TrialPracticeGuideConsolidated.

such as that taught by Ohsaki, would also protect the sensor's internal components in a manner similar to Aizawa's flat acrylic plate. Ex. 1003 ¶ 101; *see also* Ex. 1008 ¶ 15 (noting that a cover "protect[s] the LED or PD").

We disagree with Patent Owner's fourth argument that a person of ordinary skill in the art would not have modified Aizawa as proposed because a convex cover would be prone to scratches and because other alternatives existed. Patent Owner does not explain how the potential presence of scratches on a convex cover would preclude that cover's ability to, nonetheless, protect the internal sensor components in Aizawa, as Petitioner proposes. That a convex cover may be more prone to scratches than Aizawa's flat cover is one of numerous tradeoffs that a person of ordinary skill in the art would consider in determining whether the benefits of increased adhesion, signal strength, and protection outweigh the potential for a scratched cover. *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006). Moreover, as Petitioner notes, and Patent Owner does not dispute, a scratch resistant material could be employed in fabricating the cover. Pet. Reply 33; PO Sur-reply 23. The record does not support the premise that the possibility of scratches alone would have dissuaded a person of ordinary skill in the art from the proposed modification, to achieve the benefits identified by Petitioner.

For the foregoing reasons, we are persuaded by Petitioner's contentions.

vii. "[f] a handheld computing device in wireless communication with the physiological sensor device, wherein the handheld computing device comprises"

Petitioner's Contentions

Petitioner contends that the combination of, *inter alia*, Aizawa and Inokawa teaches a sensor device that is in wireless communication with a base device through its LEDs, wherein that base device is connected further to a PC. Pet. 24, 54; *see, e.g.*, Ex. 1006 ¶ 15 ("a transmitter for transmitting the measured pulse rate data to a display for displaying the pulse rate data"); Ex. 1008 ¶¶ 75 (sensed physiological information is transmitted from the sensor to the base device and, further, "[t]he base device 17 . . . transmits this information to the PC 59"), 76, 77.

Petitioner also contends that Mendelson-2006 discloses a body-worn pulse oximetry system including a sensor module, a receiver module, and a PDA. Pet. 26; *see, e.g.*, Ex. 1010, 1–2 (describing system), Fig. 1 (sensor attached to skin), Fig. 3 (PDA). Petitioner contends that signals are wirelessly transmitted to the PDA through a receiver module. Pet. 26–28; Ex. 1010, 2. Petitioner contends that wireless transmission to a PDA, as discussed in Mendelson-2006, provides advantages such as offering "a low-cost touch screen interface," and "more effective medical care." Pet. 27–28; Ex. 1010, 3–4.

Petitioner contends that a person of ordinary skill in the art "would have also found it obvious to implement the physiological sensor device resulting from the combined teachings of Aizawa, Inokawa, and Ohsaki as part of a physiological measurement system including a handheld computing device, and to enable the physiological sensor device to communicate

wirelessly with the handheld computing device," to obtain the advantages taught by Mendelson-2006. Pet. 25, 25–30, 41 n.5; Ex. 1003 ¶¶ 88–97, 125–128.

Patent Owner's Arguments

Patent Owner disputes Petitioner's contentions. Patent Owner argues that Petitioner's proposed combination is rooted in hindsight and results in a more complicated system. PO Resp. 58, 59. Specifically, Patent Owner characterizes Petitioner's combination as

> (1) eliminat[ing] Aizawa's existing transmitter so the resulting device will not require "a separate RF circuit"; (2) chang[ing] Aizawa's structure to add a second LED to transmit data using a base station, which would also require that a user remove the sensor before any data transfer can occur and thus eliminate the ability to display data in real-time; and then (3) add[ing] back in a separate communications circuit to the base station based on Mendelson 2006 so that the base station can send data to a PDA with a touch screen display.

Id. at 58–60 (citing, e.g., Ex. 2004 ¶ 114). Patent Owner further argues that such a modification eliminates the desired real-time monitoring employed by Mendelson-2006. *Id.* 58–59 (citing Ex. 2004 ¶¶ 113, 115).[8]

Analysis

As discussed above in Section II.D.5.iii, we determine that Petitioner demonstrated sufficiently that a person of ordinary skill in the art would have found it obvious to modify Aizawa to include an additional LED to, *inter alia*, allow for wireless transmission of sensed pulse rate and motion

[8] We do not address Patent Owner's argument that Mendelson-2006 does not disclose a "multi-emitter/multi-detector sensor" because Mendelson-2006 is not relied upon for such limitations. *See supra* § II.D.iii, iv.

data to a base device. We further noted that although Aizawa discloses transmission of data for display (Ex. 1006 ¶¶ 15, 35), Aizawa is silent as to how the data is transmitted or displayed. In light of the combination with Inokawa, therefore, Aizawa's multiple LEDs would have allowed wireless transmission of data to a base device. *See, e.g.*, Ex. 1008 ¶ 76 ("[V]ital sign information stored in the memory 63, such as pulse and body motion, is transmitted to the base device 17 using the S-side infrared LED 23 of the pulse sensor 1 and the B-side PD 45 of the base device 17.").

Inokawa further discloses that the base device, once it receives information from the sensor, "transmits this information to the PC 59." *Id.* ¶¶ 75, 67, 77. As described by Dr. Kenny, "the physiological sensor device's sensor component transmits physiological measurement data to an included base station via an optical communications interface, and the physiological sensor device's base station transmits signals responsive to a physiological parameter to a computer, via a network interface." Ex. 1003 ¶ 81.

With this backdrop, we are persuaded by Petitioner's contention that it would have been obvious to implement the physiological sensor device resulting from the combined teachings of Aizawa, Inokawa, and Ohsaki as part of a physiological measurement system that includes a handheld computing device. Indeed, Aizawa and Inokawa already teach the desirability of transmitting sensed data to, e.g., a computer or a display, although neither discloses further detail. *See, e.g.*, Ex. 1006, 15; Ex. 1008 ¶ 75; *see also* Ex. 1047 ¶ 56 (Aizawa is silent). In light of these teachings, we credit Dr. Kenny's testimony that transmitting sensed data wirelessly to a handheld computing device, as taught by Mendelson-2006, would have

achieved the identified benefits of, e.g., providing a low-cost display with a simple user interface and easy activation of functions and the ability to provide more effective medical care (Ex. 1003 ¶¶ 93–95). *See, e.g.*, *id.* ¶¶ 88–97, 125–128; Ex. 1047 ¶ 79. We are also persuaded that this would have been within the skill level of an ordinary artisan and would have achieved predictable results. Ex. 1003 ¶ 96.

We do not agree with Patent Owner's characterization of the proposed combination. Petitioner does not propose "(1) eliminat[ing] Aizawa's existing transmitter . . . (2) chang[ing] Aizawa's structure to add a second LED to transmit data using a base station . . .; and then (3) add[ing] back in a separate communications circuit to the base station." *Contra* PO Resp. 58–59; Ex. 1047 ¶ 77. As discussed above, Petitioner proposes that the system suggested by, *inter alia*, Aizawa and Inokawa—which includes a sensor in communication with a base device, and which contemplates additional communication from the base device to a PC—further includes a handheld computing device in wireless communication with that system. In other words, Petitioner's proposed combination effectively replaces or supplements Inokawa's PC 59 with a PDA, such as that taught by Mendelson-2006. Thus, in Petitioner's proposed combination, physiological data is sensed by Aizawa's sensor, transmitted to a base device through an additional LED, as taught by Inokawa, and further transmitted to, *inter alia*, a PDA, as taught by Mendelson-2006. *See, e.g.*, Pet. 24–30; *see also id.* at 41 n.5 (describing the proposed combination as, *inter alia*, adding "Inokawa's base station to Aizawa's physiological sensor device such that the sensor device includes a sensor and a base station with which the sensor communicates and through which the sensor communicates with a handheld

device"). Indeed, both Aizawa and Inokawa expressly contemplate transmission to an additional computing device (*see, e.g.*, Ex. 1006, 15; Ex. 1008 ¶ 75); Petitioner's proposed modification merely states that such transmission occurs wirelessly to a handheld device. The record supports this contention.

We have considered Dr. Madisetti's testimony, but it is based on the same mischaracterization put forth by Patent Owner. Ex. 2004 ¶¶ 112 (mischaracterizing the combination), 114 (same). Notwithstanding this misrepresentation of the proposed modification, Dr. Madisetti does not dispute Dr. Kenny's testimony that wireless transmission to a handheld computing device would have achieved the identified benefits, such as a low-cost device that improves medical care. *See id.* ¶¶ 112–118. As such, we credit Dr. Kenny's unrebutted testimony.

Patent Owner and Dr. Madisetti further criticize the combination, asserting that Mendelson-2006's wireless transmission exists to allow real-time monitoring, which is impossible where a sensor must be mounted on a base device to transfer information through LEDs. *Id.* ¶ 113; PO Resp. 59. However, as discussed in Section II.D.iii above, the lack of real-time measurement and transmission is simply one consideration among many. As noted in Inokawa, real-time wireless communication has its drawbacks. Ex. 1008 ¶ 5. We discern that a skilled artisan would have weighed these competing interests. "[A] given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine." *Medichem*, 437 F.3d at 1165 (citation omitted).

viii. "[g] one or more processors configured to wirelessly receive one or more signals from the physiological sensor device, the one or more signals responsive to at least a physiological parameter of the user"

The cited evidence supports Petitioner's contention that Mendelson-2006 describes wirelessly transmitting vital physiological information acquired from a sensor to a PDA, which receives it. Pet. 57–58; *see, e.g.*, Ex. 1010, 1, 2 ("The PDA can monitor multiple wearable pulse oximeters simultaneously and allows medics to collect vital physiological information to enhance their ability to extend more effective care to those with the most urgent needs."), 3 (explaining that the PDA "has sufficient computational resources for the intended application" and "can also serve to temporarily store vital medical information received from the wearable unit"), 3 ("The [PDA's graphical user interface] also displays the subject's vital signs, activity level, body orientation, and a scrollable PPG waveform that is transmitted by the wearable device."), Fig. 3 (displaying SpO_2 and HR data); Ex. 1003 ¶¶ 129–132.

As discussed above, Petitioner's proposed combination involves transmission of sensed data from Aizawa's physiological sensor to a base device, as taught by Inokawa, and further wireless transmission of that data from the base station to a handheld computing device, such as a PDA. *See supra* §§ II.D.5.iii (transmission to base station accomplished with an additional LED, as taught by Inokawa), II.D.5.vii (further transmission from base device to, e.g., a PC and/or PDA, as taught by Mendelson-2006, and contemplated by Aizawa and Inokawa). In light of these teachings, we are persuaded by Petitioner's contention that a person of ordinary skill in the art "would have found it obvious to configure a processor of the PDA to wirelessly receive signals from the physiological sensor device" taught by

the combination of, *inter alia*, Aizawa, Inokawa, and Mendelson-2006, wherein "the signals [are] responsive to physiological parameters of the user." Pet. 57–58; *see, e.g.*, Ex. 1003 ¶ 132.

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny. Ex. 1003 ¶¶ 129–132. Patent Owner does not present any argument against this limitation, apart from the arguments already addressed in Section II.D.5.vii.

ix. "[h]–[j] a touch-screen display configured to provide a user interface, wherein: the user interface is configured to display indicia responsive to measurements of the physiological parameter, and an orientation of the user interface is configurable responsive to a user input"

The cited evidence supports Petitioner's contention that Mendelson-2006 describes a PDA with a touchscreen display configured to display indicia responsive to measurements of, e.g., SpO_2 and HR. Pet. 58–61; *see, e.g.*, Ex. 1010, 3 ("The use of a PDA . . . also provides a low-cost touch screen interface.").

Petitioner acknowledges that "Mendelson-2006 does not explicitly state that an orientation of the GUI provided by the PDA is configurable responsive to a user input." Pet. 60. However, Petitioner contends that a person of ordinary skill in the art would have understood that "the LabVIEW software that was used 'to control all interactions between the PDA and the wearable unit via [t]he graphical user interface' included the option to configure an orientation of a user interface," e.g., by setting the report orientation to portrait or landscape view. *Id.* at 60–61 (alteration in

original); *see, e.g.*, Ex. 1003 ¶¶ 133–138; Ex. 1027, 186 ("Set the report orientation—portrait or landscape.").

Petitioner further contends that, in light of these teachings, a person of ordinary skill in the art "would have found it obvious to make an orientation of the PDA's user interface configurable responsive to a user input, for the sake of user convenience." Pet. 61; *see, e.g.*, Ex. 1003 ¶ 138.

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 133–138. Patent Owner does not present any argument against this limitation, apart from the arguments already addressed in Section II.D.5.vii.

x. "[k] a storage device configured to at least temporarily store at least the measurements of the physiological parameter"

The cited evidence supports Petitioner's contention that Mendelson-2006 teaches that the PDA is configured to store vital medical information received from the wearable pulse oximeter, and that an ordinarily skilled artisan "would have understood that the vital medical information would have included measurements of the physiological parameters obtained by the physiological sensor device (e.g., SpO_2 and HR)." Pet. 62; Ex. 1010, 3 ("The PDA can also serve to temporarily store vital medical information received from the wearable unit."); Ex. 1003 ¶ 140. Thus, Petitioner contends that a person of ordinary skill in the art "would have configured a storage device of the PDA to at least temporarily store measurements of physiological parameters (e.g., SpO_2 and HR)." Pet. 62; *see, e.g.*, Ex. 1003 ¶ 139.

Petitioner's stated reasoning for the proposed modification is sufficiently supported, including by the unrebutted testimony of Dr. Kenny. *See, e.g.*, Ex. 1003 ¶¶ 139–140. Patent Owner does not present any argument against this limitation, apart from the arguments already addressed in Section II.D.5.vii.

xi. Reasonable Expectation of Success

Patent Owner argues that Petitioner has failed to demonstrate a reasonable expectation of success because Dr. Kenny did not perform a design analysis to create a functional sensor. PO Resp. 61–62. We disagree. As discussed in detail above, each of Petitioner's proposed modifications to Aizawa—whether to include a second emitter, as taught by Inokawa; or to include a cover with a convex surface, as taught by Ohsaki; or to communicate with a handheld computing device, as taught by Mendelson-2006—is rooted in explicit teachings of the prior art, and is supported by persuasive declarant testimony.

We credit Dr. Kenny's testimony that, for each proposed modification, the combined prior art teachings would have been applied as known, to achieve predictable results. *See, e.g.*, Ex. 1003 ¶¶ 86 (applying Inokawa's teachings would have been "nothing more than the use of a known technique to improve similar devices in the same way and combining prior art elements according to known methods to yield predictable results," e.g., improving Aizawa's sensor "to detect and record body motion in addition to blood flow"), 102 (applying Ohsaki's teachings would have been "nothing more than the use of a known technique to improve similar devices in the same way," which would "improve adhesion to a subject's skin and

reduce variation in the signals detected by the sensor”), 96 (“[A]pplying Mendelson-2006’s . . . would have led to predictable results without altering or hindering the functions performed by the sensor.”). For similar reasons discussed above with respect to each proposed modification, we conclude that that a skilled artisan would have had a reasonable expectation of success. *See supra* § II.D.5.iii, vi, vii–x; Ex. 1003 ¶¶ 79–140.

xii.Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

6. Independent Claim 21

Independent claim 21 consists of limitations that are substantially similar to elements [a]–[f] of claim 1. *Compare* Ex. 1001, 44:51–45:15, *with id.* at 46:31–49 (reciting that the convex surface is “located between tissue of the user and all of the at least four detectors,” instead of “above all of the at least four detectors” as in claim 1; omitting details of the “handheld computing device”). In asserting that claim 21 also would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006, Petitioner refers to the same arguments presented as to claim 1. *See* Pet. 87–89; Ex. 1003 ¶¶ 173–179. Patent Owner relies on the same arguments discussed above regarding claim 1. PO Resp. 11–61.

For the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 21 would have been obvious over the cited combination of references. *See supra* § II.D.5.

7. Dependent Claims 12, 18, and 29

Dependent claim 12 ultimately depends from independent claim 1 and further recites "the protruding convex surface protrudes a height between 1 millimeter and 3 millimeters." Ex. 1001, 45:65–67.

Dependent claim 18 ultimately depends from independent claim 1 and further recites "the protruding convex surface protrudes a height greater than 2 millimeters and less than 3 millimeters." *Id.* at 46:23–23. Dependent claim 29 ultimately depends from independent claim 21 and includes the same further limitation as claim 18. *Id.* at 48:14–16.

Petitioner contends that the sensor rendered obvious by the combined teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006 would have included a cover with a protruding convex surface. *See supra* § II.D.5.vi. With respect to claim 12, Petitioner contends that a person of ordinary skill in the art "would have found it obvious that a device designed to fit on a user's wrist would be on the order of millimeters," consistent with Ohsaki's disclosure that the device is in "intimate contact" with the user's skin. Pet. 78–79 (citing, e.g., Ex. 1003 ¶¶ 159–160). Petitioner also contends that an ordinarily skilled artisan would have taken user comfort into account when establishing the dimensions of the device's convex cover. *Id.* With these considerations in mind, Petitioner contends that, "in order to provide a comfortable cover featuring a protruding convex surface that prevents slippage, the surface should protrude a height between 1 millimeter and 3 millimeters," because "there would have been a finite range of possible protruding heights, and it would have been obvious to select a protruding height that would have been comfortable to the user." *Id.* (citing, e.g., Ex. 1003 ¶ 161). With respect to claims 18 and 29, Petitioner incorporates

its contentions regarding, *inter alia*, claim 12. Pet. 87, 93; Ex. 1003 ¶¶ 169, 191.

Patent Owner argues that none of the cited references disclose the claimed height range and that Petitioner relies on hindsight reconstruction. PO Resp. 63–64 (citing, e.g., Ex. 2004 ¶¶ 121–124). Patent Owner also characterizes Dr. Kenny's testimony as conclusory and unsupported. *Id.* at 65–66.

Petitioner is correct that, "[w]hen there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product . . . of ordinary skill and common sense." *KSR*, 550 U.S. at 398. Petitioner has shown sufficiently that only a finite number of solutions existed with respect to the height of a convex protrusion on a tissue-facing sensor, which would have met the art-recognized goals of both (1) intimate contact between the sensor's surface and the user and (2) user comfort. *See, e.g.*, Ex. 1009 ¶¶ 6, 25. Bearing in mind these considerations, we credit Dr. Kenny's testimony that it would have been obvious, "in order to provide a comfortable cover featuring a protruding convex surface that prevents slippage, [that] the surface should protrude a height between 1 millimeter and 3 millimeters," as recited in claim 12, and which further includes the claimed range of 2 to 3 millimeters as recited in claims 18 and 29. Ex. 1003 ¶ 161. Further, the record does not support that any new and unexpected results were achieved at the claimed height greater than 2 millimeters and less than 3 millimeters.

We have considered Patent Owner's argument, and Dr. Madisetti's cited testimony. However, it is not dispositive that none of Mendelson-799,

Ohsaki, Schulz, or Mendelson-2006 teach the claimed range. PO Resp. 63; Ex. 2004 ¶¶ 122. Petitioner relies upon the knowledge, ability, and creativity of a person of ordinary skill in the art, not the teachings of a specific reference. Notably, Dr. Madisetti does not dispute Dr. Kenny's position that there were a finite number of options available for the height of the convex surface. Ex. 2004 ¶¶ 121–124. Therefore, we do not agree that Petitioner's contentions are rooted in impermissible hindsight. *See, e.g.*, *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971) ("Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made and does not include knowledge gleaned only from applicant's disclosure, such a reconstruction is proper.").

Accordingly, for the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 12, 18, and 29 would have been obvious over the cited combination of references.

8. Dependent Claims 2–8, 10, 11, 13, 15–17, and 19–28

Petitioner also contends that claims 2–8, 10, 11, 13, 15–17, and 19–28 would have been obvious based on the same combination of prior art addressed above. These challenged claims all depend directly or indirectly from independent claim 1 or 21. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of these claims, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. Pet. 62–87, 89–93.

Petitioner also supports its contentions for these claims with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 141–172, 180–191.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claims 1 and 21. PO Resp. 62 ("T]he Petition fails to establish that independent claims 1 and 21 are obvious in view of the cited references of Ground 1 and therefore fails to establish obviousness of any of the challenged dependent claims."); *see supra* § II.D.5.

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–8, 10, 11, 13, 15–17, and 19–28 would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, and Mendelson-2006, for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny

9. Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claims 1–8, 10–13, and 15–29 would have been obvious over the cited combination of references.

E. Obviousness over the Combined Teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Bergey

Petitioner contends that claim 9 would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Bergey. Pet. 93–96.

1. Overview of Bergey (Ex. 1016)

Bergey is a U.S. patent titled "Solid State Watch with Magnetic Setting," and discloses a watch in which the electronics are "hermetically sealed in the watch case to be free of dust and moisture." Ex. 1016, code (57). Moreover, the electronic components are "resiliently mounted for improved shock resistance." *Id.*

Petitioner contends that it would have been obvious to have modified the sensor of Aizawa-Inokawa-Ohsaki-Mendelson-2006 to hermetically seal the sensor components within the substrate, wall, and cover, so as to obtain advantages disclosed by Bergey, e.g., to protect the electronics and prevent condensation within the case. Pet. 88–89 (citing Ex. 1003 ¶¶ 278–281; Ex. 1016, code (57), 2:56–67, 8:48–9:34).

2. Analysis

Petitioner also contends that claim 9 would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Bergey. Pet. 93–96. Claim 9 depends indirectly from independent claim 1. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of this claim, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. *Id.* Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 76–76, 192–196.

Patent Owner does not present any argument for this claim other than those we have already considered with respect to independent claim 1. PO Resp. 66 ("Bergey's alleged disclosure of a hermetically sealed watch does not fix the deficiencies identified for Ground 1."); *see supra* § II.D.

We have considered the evidence and arguments of record, including those directed to claim 1 and addressed above, and we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 9 would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Bergey for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny. *See, e.g.*, Ex. 1016, 8:48–9:34; Ex. 1003 ¶¶ 192–196.

F. Obviousness over the Combined Teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Goldsmith

Petitioner contends that claim 14 would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Goldsmith. Pet. 96–100.

1. Overview of Goldsmith (Ex. 1011)

Goldsmith is a U.S. patent application publication titled "Watch Controller for a Medical Device," and discloses a watch controller device that communicates with an infusion device to "provid[e] convenient monitoring and control of the infusion pump device." Ex. 1011, codes (54), (57).

Goldsmith's Figures 9A and 9B are reproduced below.

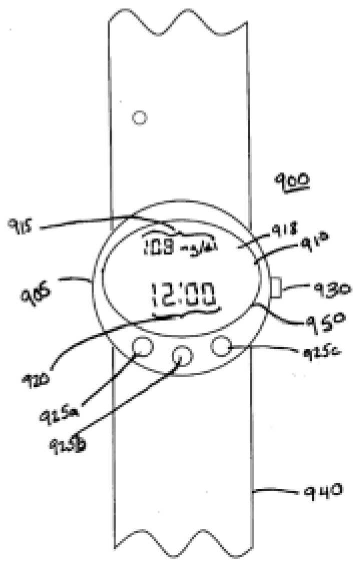


FIG.9A

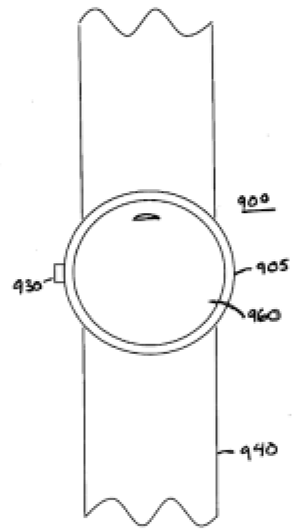


FIG 9B

Figure 9A and Figure 9B are respective front and rear views of a combined watch and controller device. *Id.* ¶¶ 30–31. As shown in Figure 9A, watch controller 900 includes housing 905, transparent member 950, display 910, input devices 925a–c, scroll wheel 930, and wrist band 940. *Id.* ¶¶ 85–86. Figure 9B shows rear-side cover 960, and a rear view of housing 905, scroll wheel 930, and wrist band 940. *Id*.

Goldsmith discloses the watch controller may interact with one or more devices, such as infusion pumps or analyte monitors. *Id.* ¶ 85; *see also id.* ¶ 88 ("The analyte sensing device 1060 may be adapted to receive data from a sensor, such as a transcutaneous sensor."). Display 910 "may display at least a portion of whatever information and/or graph is being displayed on the infusion device display or on the analyte monitor display," such as, e.g., levels of glucose. *Id*. ¶ 86. The display is customizable in a variety of configurations including user-customizable backgrounds, languages, sounds, font (including font size), and wall papers. *Id*. ¶¶ 102, 104. Additionally, the watch controller may communicate with a remote station, e.g., a

computer, to allow data downloading. *Id*. ¶ 89 (including wireless). The remote station may also include a cellular telephone to be "used as a conduit for remote monitoring and programming." *Id.*

2. Analysis

Petitioner also contends that claim 14 would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Goldsmith. Pet. 96–100. Claim 14 depends indirectly from independent claim 1. Petitioner identifies teachings in the prior art references that teach or suggest the limitations of this claim, and provides persuasive reasoning as to why the claimed subject matter would have been obvious to one of ordinary skill in the art. *Id*. Petitioner also supports its contentions for this claim with the testimony of Dr. Kenny. Ex. 1003 ¶¶ 77–78, 197–202.

Patent Owner does not present any argument for this claim other than those we have already considered with respect to independent claim 1. PO Resp. 66–67 ("Goldsmith's alleged disclosure of a watch controller device with a display does not fix the deficiencies identified for Ground 1."); *see supra* § II.D.

We have considered the evidence and arguments of record, including those directed to claim 1 and addressed above, and we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 14 would have been obvious over the combined teachings of Aizawa, Inokawa, Ohsaki, Mendelson-2006, and Goldsmith for the reasons discussed in the Petition and as supported by the testimony of Dr. Kenny. *See, e.g.*, Ex. 1011 ¶¶ 11, 87, 95, 102; Ex. 1003 ¶¶ 197–202.

III. CONCLUSION

In summary:[9]

Claims	**35 U.S.C. §**	**Reference(s)/ Basis**	**Claims Shown Unpatentable**	**Claims Not Shown Unpatentable**
1–8, 10–13, 15–29	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006	1–8, 10–13, 15–29	
9	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006, Bergey	9	
14	103	Aizawa, Inokawa, Ohsaki, Mendelson-2006, Goldsmith	14	
Overall Outcome			1–29	

[9] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–29 of the ’765 patent have been shown to be unpatentable; and

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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